

NOTEWORTHY MOSSES & LIVERWORTS OF MINNESOTA

PART II

Species Fact Sheets



Joannes A. Janssens

2014 Minneapolis

© 2014 State of Minnesota, Department of Natural Resources
Unless otherwise credited, all images and maps are courtesy of Joannes A. Janssens © 2014.

Cite as: Janssens, J.A. 2014. Noteworthy Mosses & Liverworts of Minnesota, Part II: Species Fact Sheets.
Minnesota Department of Natural Resources 2014, 208 pp.

Introduction

For Part II I have collated fact sheets for species identified by the field keys in Part I. The selection criteria used to derive these species of noteworthy mosses and liverworts are given in the introduction to Part I.

The fact sheets will print alphabetically by species name within the group to which they are designated in Part I. All fact sheets within a group are marked at the top and bottom of the page with the same color banner as used before (p. iv). The top banner has the species name and an icon specific to the species. The bottom one lists the group name. Fact sheets for three species that didn't fit specific groups and key out under the Main Key in Part I are positioned at the beginning.

Fact-sheet information is organized under the headings 'Scientific Name', 'Synonyms', 'Abundance' (including MN distribution map), 'Habitat and Field Aspect', 'Aid to Identification', and 'Look-Alike Species'.

The **Scientific Name** used is explained in the introduction to Part I (nomenclature). **Synonyms** are only given when different names are used in one of the standard floras covering our region (see Introduction to Part I, reference works).

The **Abundance Index** for each species is given for (1) number of sites and (2) of comprehensive ecotopes (see Janssens 2007 for definitions). In addition, the number of ECS subsections throughout Minnesota in which the species occurs is indicated. A five-point scale (**C**(ommon), **F**(requent), **O**(ccasional), **U**(ncommon), and **R**(are)) is used, with the number of ECS subsections given as a subscript, e.g., *Hylocomiastrum pyrenaicum* (**O**/**U**₄). If the same rank is assigned to (1) and (2), it is only mentioned once, e.g., *Brachythecium rivulare* (**C**₂). (1) is based on the species' frequency among all sites (see Janssens 2012 for database): the species (total $n = 522$) were rank-ordered based on their number of sites in which they occur. An approximate linear distribution is formed between \log_{10} (number of sites) and rank order. The species list was proportioned among the four highest abundance classes, each class assigned one quartile of the \log_{10} (number of sites) range (**C** = 375-85 sites, $n = 68$; **F** = 84-20, $n = 139$; **O** = 19-5, $n = 149$; **U** = 4-1, $n = 143$). The **R**(are) species ($n = 24$) are those proposed as Endangered, Threatened, or Special Concern for the state of Minnesota (Janssens 2010). (2) is based on the same procedure of abundance classification but using only species recorded from comprehensive ecotopes (total $n = 395$: **C** = 231-59 ecotopes, $n = 50$; **F** = 58-15, $n = 109$; **O** = 14-4, $n = 107$; **U** = 3-1, $n = 116$; **R** (see above), $n = 13$).

A **Minnesota dot-distribution map**, showing the four major provinces of the Ecological Classification System (MN DNR 2003-2006), marks all sites from which I have seen and checked vouchers.

Habitat and Field Aspect describes micro- and mesohabitat for the species, and some of its associated characteristic growth forms. The photographs are my own, except when otherwise noted (see the introduction to Part I for more detail on legend and scaling).












Aid to Identification compares the species with its congeners and look-alikes. Only characters of field aspect and what can be studied by handlens is discussed. Character states printed in **blue bold** styling are the ones, often in combination, that differentiates the species from the others.

The **Look-Alike Species** section lists other species with a similar field aspect as the species under discussion. They should be considered as possible alternatives when the name of the species has been printed in blue font in the field keys of Part I. If critical identification is desired, it will be necessary to collect a voucher specimen and study it in the laboratory using the standard floras listed above. The MN abundance (see above) of the look-alike species is given in parentheses when its name is first introduced.

The **Associated Species** section lists the most common species in order of descending frequency, compiled at two or three levels. (1) The 'MesoHab' list is based on a tally of the number of comprehensive ecotopes (Janssens 2007) in which the associate species occurs with the one under discussion; (2) 'MicroHab' on a tally of associates on similar substrate type (only given for forested mesohabitat with high differentiation among substrate types, Janssens 2007); and (3) 'Pop' on a tally of associates occurring within mixed populations, where the species make intimate physical contact with each other. In some cases the species sequence might be the same for two or all three levels, and then only a single list is given.

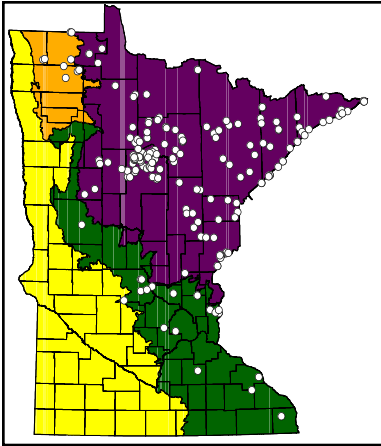
See the Introduction to Part I for Acknowledgments and its Appendix for Literature Cited.

Groups

	Thalloid Liverworts 4 species		Feather Mosses 6 species
	Leafy Liverworts 6 species		Costate Wetland Pleurocarps 12 species
	Sphagnum 16 species		Costate Upland Pleurocarps 9 species
	Polytrichales 3 species		Ecostate Pleurocarps on Peat 5 species
	Dicranum 7 species		Ecostate Pleurocarps on Bark, Wood, Rock 6 species
	Other Acrocarps 16 species	and separate fact sheets for: <i>Climacium dendroides</i> <i>Fissidens adianthoides</i> <i>Plagiothecium denticulatum</i>	

MAIN-KEY SPECIES

CLIMACIUM DENDROIDES



Abundance: Common (C_{20}).

Habitat and field aspect: Common in northern and southern wet forest and in northern, northwestern, and southern forested rich peatland, usually associated with black ash, tamarack, and white cedar, less frequently with black spruce; in northern wet meadow/carr associated with alder. Frequent along Lake Superior rocky shore. Occasional encountered in drier mesohabitat such as northern and central mesic hardwood and mixed forest and northern dry to mesic fire-dependent woodland. Found in northern rich and extreme rich fen. Recorded from northern wet and southern moderate cliff, from acid peatland, either poor conifer swamp or transitional fen, and from northern terrace floodplain forest. The species is **dendroid (tree-like)** in habit and forms often expansive clones, but also occurs as scattered plants among other bryophytes or on bare forest floor.

Aid to Identification: Younger plants look quite compact and like a small tree, but more mature ones in wetter habitat less so, with their upper branches intertwined so that the individual plants are less easily differentiated. The **'stems' are primary branches** that grow upright from **horizontal rhizomes**. These upright branches look naked, but have scale-like 'stem' leaves. The secondary **leafy branches are clustered at the tip**, arranged either radially or somewhat pin-



typical dendroid or tree-like plants; population of mature plants in a depression in hardwood forest



CLIMACIUM DENDROIDES

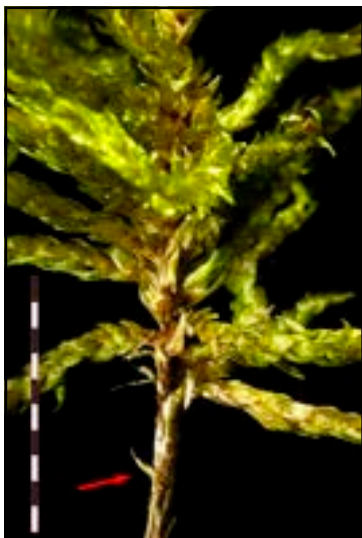
nately. Between the branch leaves **paraphyllia** can be found (20x handlens).

Look-Alike Species: *Climacium americanum* (O_2) occurs only in the southern part of the state. It is a duller green, but all other diagnostic characters have to be studied using a microscope; hybrids are also suspected. Other weft-forming pleurocarpous species with somewhat of a dendroid habit are *Hylocomiastrum pyrenaicum* (O_3), *Hylocomium splendens* (C_{12}), and a modification of *Brachythecium rivulare* (C_{21}). The upright 'stems' of *H. pyrenaicum* bear regular leaves. The leaves of the tri-pinnate *Hylocomium splendens* have a double costa. *Brachythecium rivulare* has no paraphyllia and stem and branch leaves are quite similar.

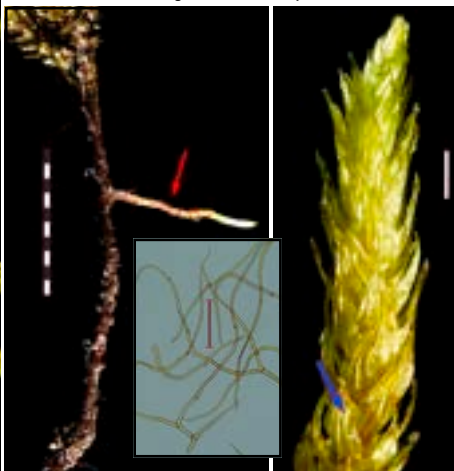
Look-Alike Species: Mesohab: *Plagiomnium ellipticum*, *Hypnum lindbergii*, *Plagiomnium cuspidatum*, *Callicladium haldanianum*; Microhab: *Callicladium haldanianum*, *Hypnum pallescens*, *Plagiomnium cuspidatum*, *Platygyrium repens*; Pop: *Plagiomnium ellipticum*, *Thuidium delicatulum*, *Hypnum lindbergii*, *Thuidium recognitum*, *Plagiomnium cuspidatum*.



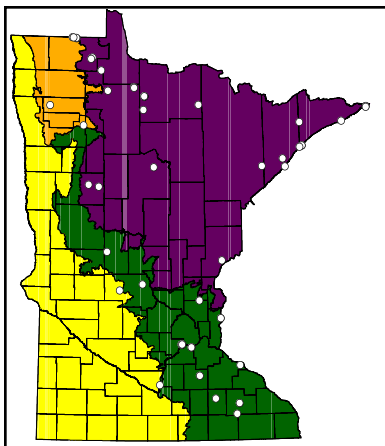
compact, distinctly tree-like younger plants in riparian mesohabitat



left: scale-like leaves on primary upright branch ('stem')
below middle: rhizome (a young one shown)
below right: branch leaves plicate



FISSIDENS ADIANTHOIDES



Abundance: Frequent (F_{16}).

Habitat and field aspect: Frequent in open rich peatland (a Minnesota calcareous-fen indicator species, but mostly occurring in northern extreme rich fen, less so in prairie extreme rich fen and northern rich fen). Also frequent in southern seepage meadow/carr, less so in northern wet meadow/carr. Occasional along North Superior Rocky shore and in northern rich spruce, tamarack, and cedar/fir swamp, and in southern rich conifer swamp. Recorded from rocky river shore, on northern wet cliff, in northern wet conifer forest and southern wet ash swamp, and in central wet-mesic hardwood forest. Usually growing as **small clones in dark shady crevices**, under tree-root bases, or hidden under dense thatch. Also found as **scattered plants among other rich-fen bryophytes**.

Aid to Identification: The *Fissidens* type of leaf structure is unique among Minnesota mosses (see the figure on p. 15 in Part I). The **leaves are strictly distichous inserted** on the stems (in two equidistant lateral rows), and their proximal part is boat shaped, formed by the **vaginant**

laminiae (blue arrows) which clasp around the stem. One of the vaginant laminiae extends beyond the other as an **apical lamina**. Below the keel, formed by the costa and the two vaginant laminiae, an **abaxial lamina** extends all the way to the tip of the leaf. In *F. adiantoides* the **upper margins of the apical and abaxial laminiae are irregularly and coarsely serrate** (20x handlens), in addition to denticulate. The **costa is mostly percurrent**, usually forming a distinct but short apiculus. **Sporophytes are produced laterally** on the stems.

Look-Alike Species: *Fissidens adiantoides* is the largest of the genus in Minnesota, with numerous pairs of leaves (often > 25). *Fissidens dubius* (F_{13}) is similar in structure, also with lateral sporophytes and irregularly serrate upper margins, but it is somewhat smaller with fewer pairs of leaves (less than < 25). Truly diagnostic distinctions between the two species, however, are microscopic. *Fissidens osmundoides* (F_9) and *F. taxifolius* (O_3), medium-sized species, have evenly crenulate or serrulate upper margins, the former with the costa ending before the apex and with terminal setae. The other *Fissidens* species are either aquatic (*F. fontanus*, U_1 , with very long, narrow leaves) or very small (*F. bryoides*, O_2 , and *F. obtusifolius*, U_2).

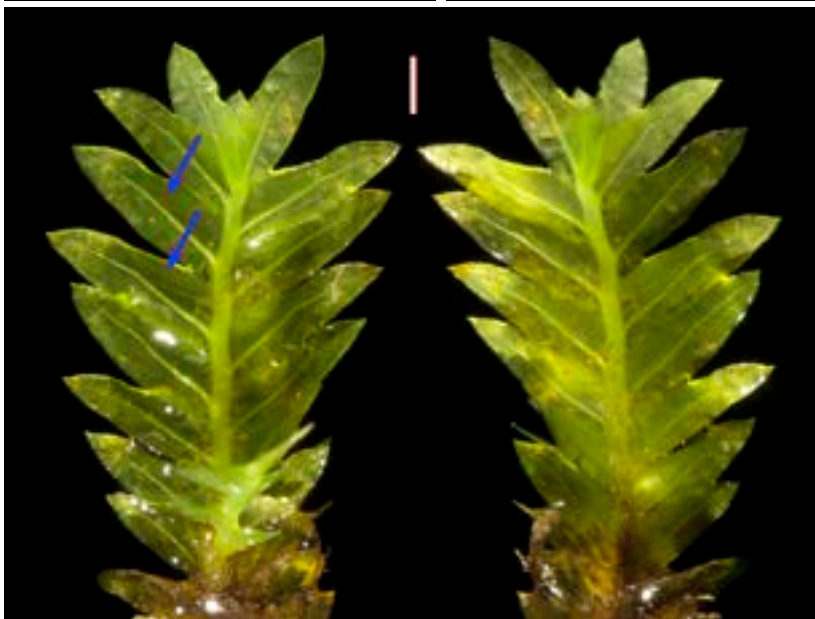
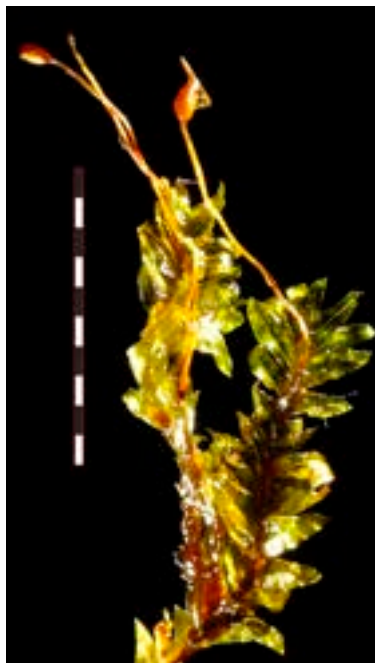
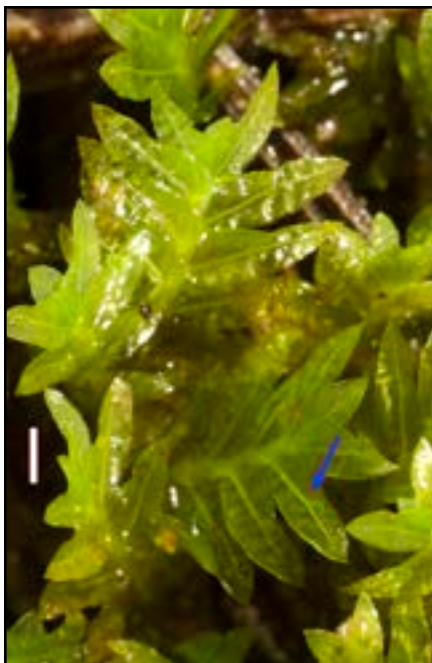
Associated Species: MesoHab: *Ptychostomum pseudotriquetrum* and *Campylium stellatum*; Pop: *Campylium stellatum*, *Ptychostomum pseudotriquetrum* and *Drepanocladus polygamus*.



distichous insertion of the many leaf pairs give the gametophores a fern frond-like appearance

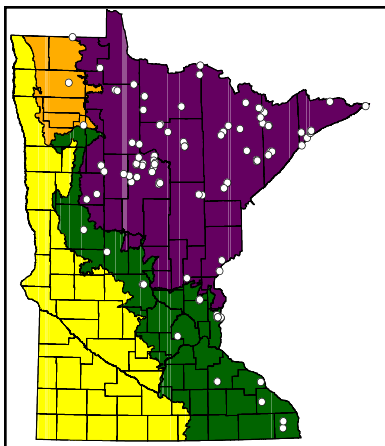


FISSIDENS ADIANTHOIDES



above left: plants distichously flattened, leaves with vaginant laminae (blue arrow) clasping around both sides of stem
 above right: the setae are attached to the sides of the plants, not terminal as in some other *Fissidens* species
 below: front and back view of single plant, vaginant laminae indicated by blue arrows; leaf margins serrate (20x handlens)

PLAGIOTHECIUM DENTICULATUM



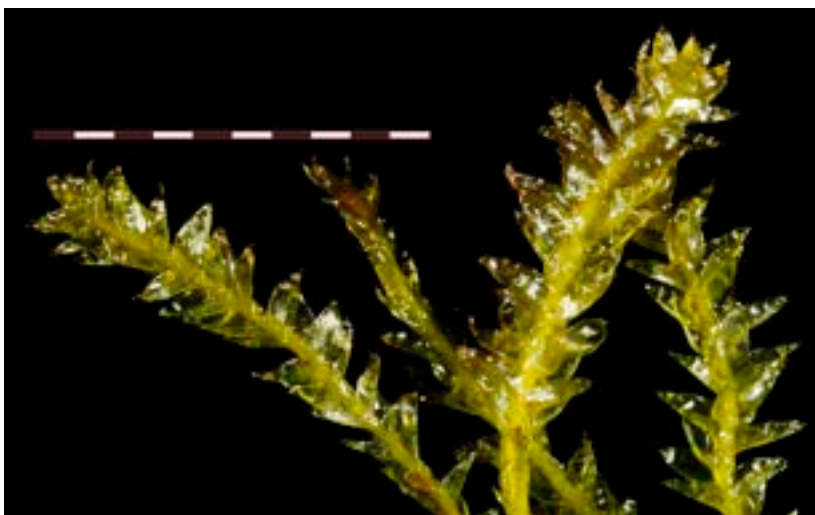
Abundance: Common (C_{19}).

Habitat and field aspect: Common in many forested rich peatland classes, most specifically in northern alder swamp, least in northern cedar/fir swamp. Frequent in northern and southern fire-dependent forest, northern wet forest, and mesic hardwood forest throughout the state. Found in forested northern acid peatland, northern and southern wet meadow/carr, and northern and prairie rich fen. Recorded from northern poor fen, mixed cattail marsh, and mesic cliff. Most often found as scattered plants growing among other bryophytes in shaded and mesic microhabitat, often in epixylic mats. Small pure clones can be found in dark recesses on organic detritus. The plants are **poorly branched, prostrate, and highly glossy**. The leaves are **strictly complanate**, facing the source of light.

Aid to Identification: The leaves are **asymmetrically** shaped, **ecostate**, and with a narrowly **recurved border** (20x handlens)

Look-Alike Species: *Plagiothecium laetum* (F_{13}) is similar in aspect, but usually much smaller (leafy stem width < 2 mm). Its leaf margins appear plane. The most useful diagnostic characters, however, are microscopic, based on the structure of the alar-cell region. Other *Plagiothecium* species in Minnesota (*P. cavifolium*, F_{12} and *P. latebricola*, U_2) have more terete (non-complanate) branches and less asymmetric leaves. *Hypnum pratense* (C_{20}) might be similar in size and field aspect as *P. denticulatum*, but its leaves are clearly symmetric and curved downward (decurrent) rather than outward.

Associated Species: MesoHab: *Callicladium haldanianum*, *Lophocolea heterophylla*, *Plagiomnium ellipticum*, and *Plagiomnium cuspidatum*; Microhab: *Callicladium haldanianum*, *Plagiomnium cuspidatum*, *Hypnum pallescens*, and *Platygyrium repens*; and Pop: *Lophocolea heterophylla*, *Callicladium haldanianum*, and *Plagiomnium cuspidatum*.



individual stems as they are often found scattered among other bryophytes
the complanate-oriented leaves are perpendicular to the source of light

Main-Key Species

October 2013



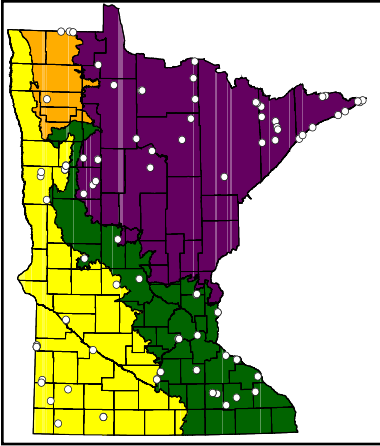
PLAGIOTHECIUM DENTICULATUM



large clones as shown here are rarely found: the asymmetric aspect and curvature of the leaves is then very obvious; the inset illustrates that the leaves are still inserted helically, however (not distichously as in *Fissidens* or leafy liverworts), but they are strongly twisted into a single plane; the recurved margins (red arrows) are also clearly visible

THALLOID LIVERWORTS

ANEURA PINGUIS



Synonym: *Riccardia pinguis*.

Abundance: Common (C_2).

Habitat and field aspect: Common in northern and prairie open rich peatland (in over half of the prairie extreme rich fens: a high-fidelity calcareous-fen indicator in Minnesota). Frequent in southern wet meadow/carr (mostly seepage meadow associated with calcareous fens). Occasional in forested rich peatland, most often encountered in northern rich spruce swamp (patterned) and southern rich conifer swamp. Recorded from northern poor black spruce swamp and southern open talus. It is most commonly found as **small clones** of a few thalli under dense thatch, rarely as larger clones with **clavate erect calyptrae** (see photo below).

Aid to Identification: **The fleshy thallus is without a darker midrib, green to yellow-green throughout, opaque when dry, somewhat translucent when wet, and with a greasy sheen.** Individual plants are often several cm long and up to 0.5 cm wide, sometimes very narrow and etiolated. The branching is irregular and new branches are soon detached. The **thallus margins**

are flat to slightly wavy. Rhizoids are rarely abundant, **colorless**, and restricted to thicker central portion of lower thallus.



Look-Alike Species: Other Metzgeriales (simple thalloid liverworts without internal tissue differentiation) that most closely resembles *Aneura pinguis* are *Moerckia hibernica* (F₂) and *Pellia* (F-O) species. These species are similar in size and often grow in similar mesohabitat. However, they have a more transparent, pellucid thallus: *Moerckia hibernica* has strongly wavy or crisped margins, and *Pellia* species have distinct blackish midribs with abundant rhizoids underneath. All other Metzgeriales (*Riccardia* spp, F/O, and *Metzgeria conjugata*, U₁) that occur in Minnesota have very narrow thallus lobes which are often highly transparent and/or fringed with cilia. The hornworts *Anthoceros macounii* (U₂) and *Phaeoceros carolinianus* (O₄) have similar undifferentiated thalli as the Metzgeriales, but the plants usually grow as distinct rosettes. When sporophytes are present, they are very dif-



above: a large extensive clone, rarely seen, with turgid, clavate, and somewhat scaly calyptrae, on detrital organic material along a lake shore

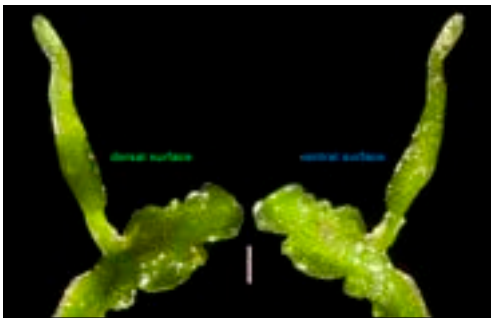
left: etiolated thalli on marl under heavy shade on the seepage surface of a calcareous fen



ANEURA PINGUIS



large separate fleshy thalli, with a greasy lustre and somewhat wavy margins, without any vegetative or reproductive structure attached, here growing on loose mineral matter at the base of a thallus slope; however, most commonly found under dense thatch in wet meadows, carrs, and open rich and extreme-rich fens



above: the ventral surface is very similar to the dorsal one in aspect, and few rhizoids are seen

right: when wet, the thallus is quite translucent and there is no distinct black midrib

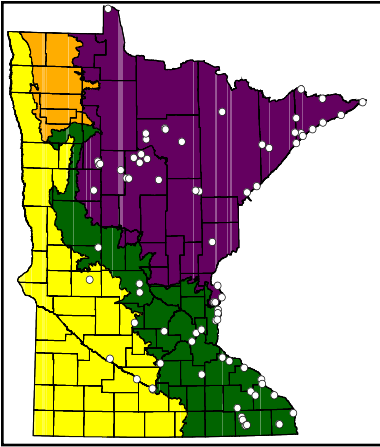


ferent form those of the liverworts, reminiscent of young grass blades.

Blasia pusilla (Blasiales, O_3) is somewhat smaller than *Aneura pinguis*, with scalloped margins and distinctive lateral dark spots (cavities occupied by *Nostoc* colonies), and surface structures containing gemmae. Several species of complex thalloid liverworts (Marchantiales and Ricciales) have also been recorded, but rarely, in calcareous fens: *Ricciocarpos natans* (O/U_8) usually an aquatic species floating on ponds and lakes, but sometimes stranded on mud flats, with ventral scales; *Riccia fluitans* (O_{12}) with very narrow, elongated, and equal dichotomous branching; and *Marchantia polymorpha* (F_{17}) with the upper surface clearly patterned by areolae with central pores.

Associated Species: MesoHab: *Ptychostomum pseudotriquetrum*, *Drepanocladus aduncus*, *Campylium stellatum*, and *Plagiommium ellipticum*; Pop: *Campylium stellatum*, *Drepanocladus aduncus*, *Ptychostomum pseudotriquetrum*, and *Scorpidium cossonii*.

CONOCEPHALUM SALEBROSUM



Synonym: *Conocephalum conicum*.

Abundance: Frequent (F₃₈).

Habitat and field aspect: Frequent on northern wet cliff, southern wet, mesic, and moderate cliff, and southern open and moderate talus slope; in northern wet conifer and northern and southern ash swamp. Occasional in northern cedar/fir swamp, but also recorded with black spruce, tamarack, and alder. In the south in rich conifer swamp. Recorded from open rich and extreme rich fen, northern mesic cedar-hardwood forest, and southern floodplain forest. Usually strongly adhering in **extensive mats** to rock walls or to decomposed peat banks in seepage areas.

Aid to Identification: *Conocephalum salebrosus* is one of our **largest thalloid liverworts** (thallus width often > 1 cm). **The complex thallus** has a dorsal surface with a **distinct pattern of areolae, clearly visible with the naked eye**. These hexagonal areas outline the upper surface of sub-epidermal air chambers, and are perforated centrally by a single large, often elliptic, raised pore, visible with the 20x handlens. The ventral surface is covered sparsely by **bundles of rhizoids and scales**,

with frequently purplish-colored appendages, the most recent ones flipped over the apical notches. Most characteristic is the **strong fragrant odor** when a small fragment of a thallus lobe is crushed.

Look-Alike Species: *Marchantia polymorpha* (F₁₇) is the only other complex thalloid liverwort similar in size, but its areolae are far less obvious. It often has gemmae cups on the dorsal surface and umbrella-shaped gametangiophores rising above it. *Conocephalum salebrosus* lacks any such specialized vegetative structures, and its gametangiophores are less tall and with a conical receptacle. The other complex thalloid liverworts (Marchantiales) occurring in Minnesota are smaller, usually less than 5 mm in thallus width and some forming distinct rosettes. The simple thalloid liverworts (Metzgeriales and Blasiales) and hornworts (Anthocerotopsida) are also smaller.

Associated Species: MesoHab: *Plagiommium cuspidatum*, *Thuidium delicatulum*, *Plagiommium ellipticum*; Pop: *Plagiommium ellipticum*, *Climacium dendroides*, *Plagiommium cuspidatum*, *Thuidium delicatulum*.



large thalli with the obvious 'alligator skin' pattern, on a sandstone cliff face



CONOCEPHALUM SALEBROSUM



above: on peat among other bryophytes in rich tamarack swamp

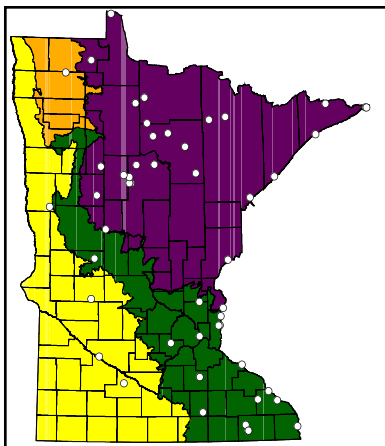


left: scales (hyaline here, indicated by red arrows) and rhizoids (white arrows) on ventral side of thallus (the areolae are visible through the translucent thallus, but only porose on the dorsal surface)

below: areola with large, central pore into air chamber beneath (ellipse and blue arrow); the small disks with reddish-purple borders (red arrows) are ventral-scale appendages turned upward and over the growing apical cell regions of this dichotomizing thallus lobe



MARCHANTIA POLYMORPHA



Abundance: Frequent (F_{17}).

Habitat and field aspect: Frequent in forested rich peatland, such as northern cedar/fir, rich tamarack/spruce swamp, and alder swamp. Found on wet cliff and open thallus, and in extreme rich fen (calcareous fen), in wet meadow/carr, and along rocky river shore. It is one of our largest liverworts, usually growing as pure thalloid mats on highly decomposed organic substrate, or on mineral substrate with a circumneutral or alkaline pH, often in somewhat disturbed areas, sometimes associated with recent fires.

Aid to Identification: A **large thalloid liverwort** (thallus width often >1 cm) with a **distinctly differentiated upper and lower surface**. The upper surface has sometimes a **interrupted darkened mid vein** and is patterned with **small areolae with a central raised pore**, under the handlens showing as dots. The rhizoids are abundant on the lower surface and often form large bundles. The scales are colorless. Most characteristic are **gemmae cups**, small splash cups filled with discoid gemmae, visible

ible with the 20x handlens, and elevated gametangiophores: **archegoniophores** (♀ , umbrella-shaped) and **antheridiophores** (♂ , disk-shaped).

Look-Alike Species: The areolae of *Marchantia polymorpha* are far smaller than those of *Conocephalum salebrosum* (F_{18}) which are obvious to the naked eye. *Marchantia*'s hexagonal pattern is usually only visible with a handlens. The species also lacks the distinctive aromatic smell of *C. salebrosum*. Not all its populations have gemmae cups, but gametangiophores are usually found: female and male clones grow in small, sometimes intermixed populations or near each other. *Marchantia aquatica* (O/U_6) has been recognized fairly recently, and a number of the Minnesota *Marchantia* populations can be assigned tentatively to this species. It appears to be growing in wetter swamp mesohabitat, and might be differentiated from *M. polymorpha* by

a very pronounced and uninterrupted darkened mid vein. Other complex thalloid liverworts occurring in Minnesota are quite a bit smaller, their thallus usually less than 5 mm in width. Large thalloid liverworts with a simple, undifferentiated thallus (Metzgeriales) and thus without areolae are *Aneura pinguis* (C_{21} , without midrib) and *Pellia* species (with midrib).



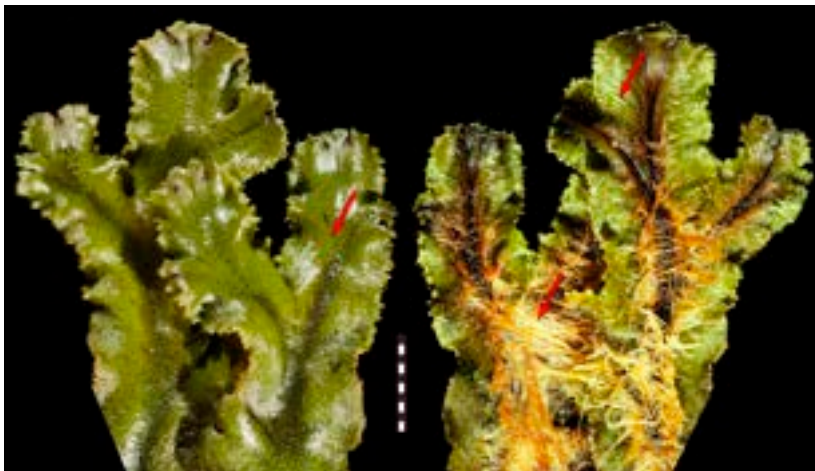
above: common microhabitat in shaded hygrophytic habitat

below: population on wet sandstone cliff with abundant gemmae cups (blue arrow) and male antheridiophores (red arrow)



MARCHANTIA POLYMORPHA

Associated Species: MesoHab: *Plagiomnium ellipticum*, *Climacium dendroides*, *Pleurozium schreberi*, *Plagiomnium cuspidatum*; Pop: *Calliergon cordifolium*, *Plagiomnium ellipticum*.



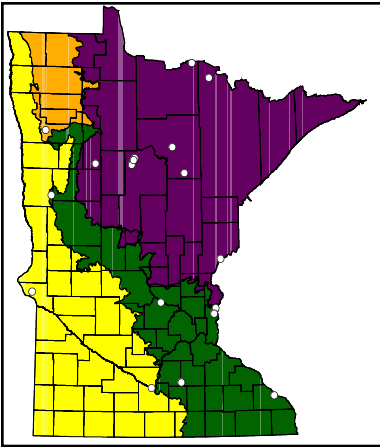
above: highly differentiated upper and lower thallus surface, the upper one with a somewhat darkened mid vein (*Marchantia aquatica*?) and very small areolae each with a centrally protruding white pore, the lower surface with large bundles of rhizoids and colorless scales

right: female plants with mature umbrella-shaped archegoniophores

below: thallus with abundant gemmae cups and scattered gemmae



RICCIA FLUITANS



Abundance: Frequent (F₁₂).

Habitat and field aspect: Occasional in northern and prairie wet meadow/car, and recorded from southern wet prairie and northern cattail-sedge marsh. Usually found floating on the surface of pond water, sometimes grounded along the margins when the water table drops. The **dichotomously branched plants** form **tangled flat discs and small mats on the water surface**. When grounded the plants are still very similar in appearance.

Aid to Identification: The **thallus segments are very narrow (< 1 mm), flat, and always green when alive**. The pores are inconspicuous, but the underlying elongated **air chambers can easily be seen** in transmitted light with the 20x handlens.

Look-Alike Species: The *Riccia* “*fluitans*” complex is challenging, and so far I have only been able to differentiate, for Minnesota, *R. rhenana* (U₁). This later species is larger, with the branches up to 2 mm wide, and a terrestrial phase that forms incomplete and firm rosettes, up to 1.5 cm in diameter. Among other *Riccia* species,

Riccia cavernosa (U₁) grows only on exposed moist soil in disturbed areas (as terrestrial phases of *R. fluitans* and *R. rhenana*). Its thallus lobes are perforated by ragged gaps on the upper surface. Schuster also lists *R. frostii*, characterized by a very acute angle between the dichotomizing branches. This species was found exposed on river bank after flooding, and as *R. cavernosa*, on disturbed moist soil. *Ricciocarpus natans* (O/U₁) has a aquatic and a terrestrial phase, as *Riccia fluitans* and *R. rhenana*, but is much more often encountered stranded. Its aquatic modification has long-pendent ventral scales hanging down into the water. Its rosettes on the pond or lake-edge mud flats are hemi- to nearly completely circular, with the terminal growing points distinctly bulbous. *Aneura pinguis* (C₂₁), a Metzgeriales liverwort without internal thallus differentiation, sometimes forms elongated thallus segments when growing in deep shade, but without the characteristic dichotomous branching and elongated aircchambers of *R. fluitans*.

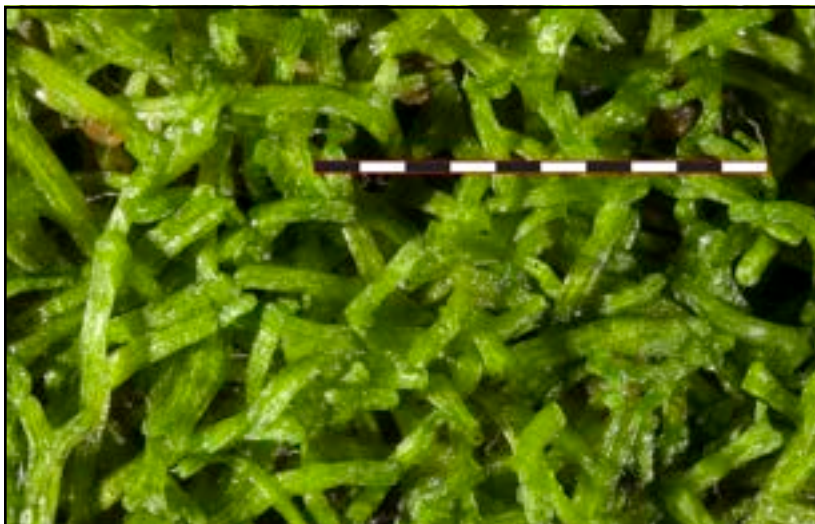
Associated Species: *Drepanocladus aduncus* is the only species that is more than by happenstance associated with the terrestrial phase of *R. fluitans*.



tangled mat of long, narrow thallus fragments, stranded during late summer on mud-covered boulders



RICCIA FLUITANS



the strap-like thallus branches are of near-equal width throughout



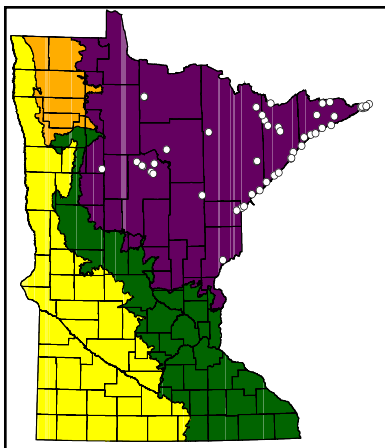
above: the regular dichotomous branching is clear on separated thalli, the angles between the branches 45° to 90° wide; the growing points are not particularly swollen

left: in transmitted light, using an older fragment, it is possible to discern the elongate airchambers underneath the upper epidermis (filled partly with air); the pores leading into them are not obvious



LEAFY LIVERWORTS

BAZZANIA TRILOBATA



Abundance: Frequent (F₁₁).

Habitat and field aspect: Frequent in northern wet conifer forest, and in wet and very wet ash swamp. Occasional in northern mixed fire-dependent forest/woodland and along Lake Superior rocky shore. Found in northern rich spruce and cedar/fir swamp. Recorded from northern poor black spruce swamp and northern mesic white cedar–yellow birch forest. Often forming pure, **weft-like and domed clones** on the forest floor in shaded and mesic to dry microhabitat.

Aid to Identification: **Three large teeth** end the truncated ovate to rectangular leaves which curve downward along both sides of the stem when the plants are dry. **Stolons** (thread-like branches with rhizoids and small rudimentary leaves) are **attached to the underside of the plants** and disappear downward into the clone, but are easily observed when a specimen is collected.

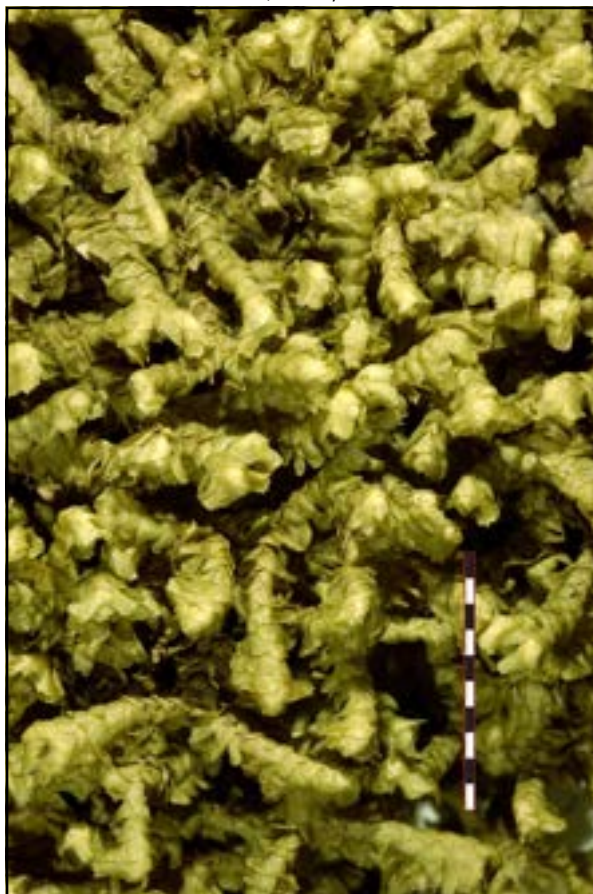
Look-Alike Species: No other *Bazzania* species, which are smaller, have yet been recorded in the state.

Bazzania trilobata is one of the largest leafy liverworts, and most easily differentiated by its weft-forming habit, large-toothed leaves, scalloped underleaves, and abundant stolons. Other sizeable leafy liverworts species with incised leaves (i.e., *Barbilophozia barbata*, F₈, or *Tritomaria quinquedentata*, F/U₃) are rather lobed than toothed (often four-lobed), and their leaves are not pointed downward along the stem when dry.

Associated Species:

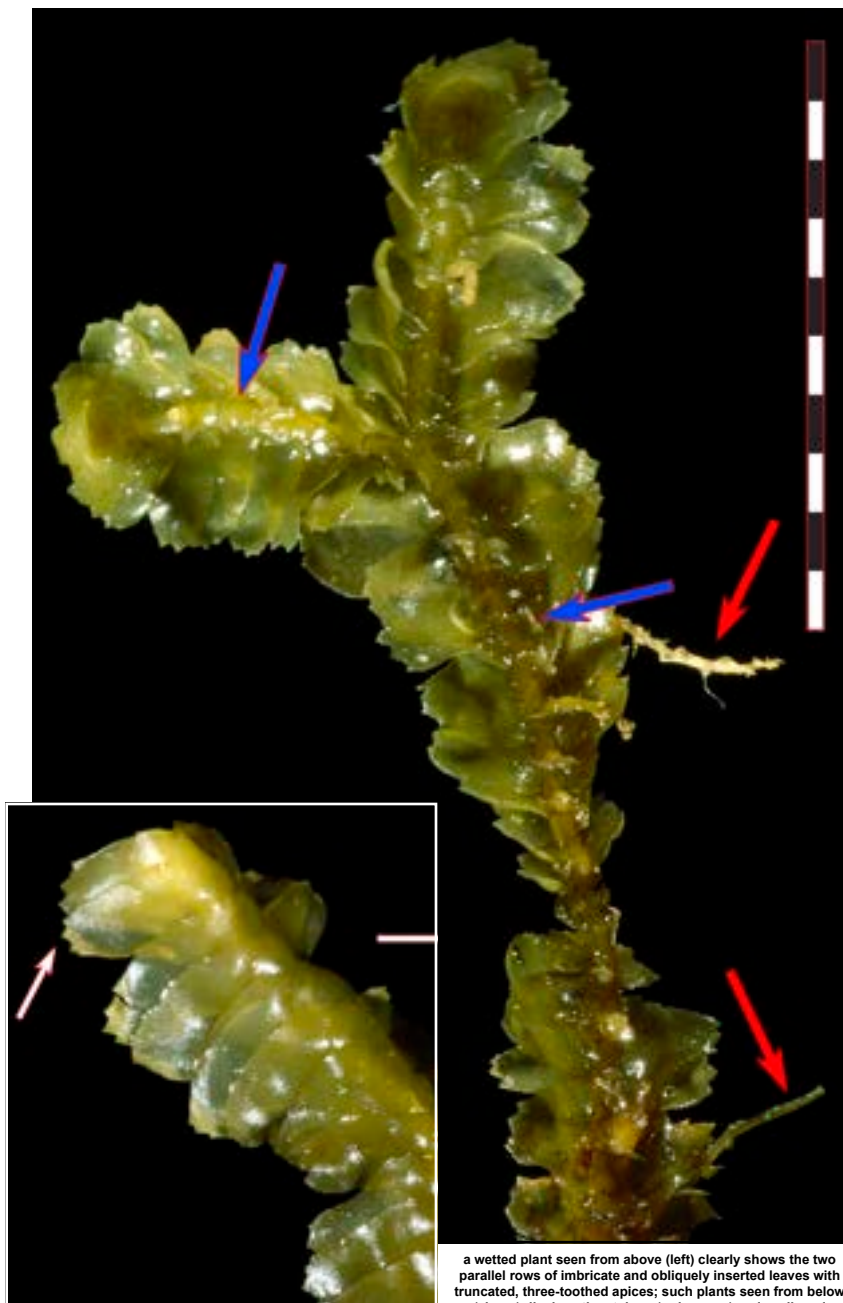
MesoHab: *Tetraphis pellucida*, *Dicranum flagellare*, *Ptilidium pulcherrimum*, *Pleurozium schreberi*; Microhab: *Callicladium haldanianum*, *Plagiomnium cuspidatum*, *Hypnum pallescens*, *Platygyrium repens*; Pop: *Dicranum flagellare*, *Tetraphis pellucida*, *Callicladium haldanianum*, *Lepidozia reptans*.

close-up of the top of domed dry clone on forest floor for mixed hardwood-white cedar upland forest; the shoots are somewhat worm-like and branch irregularly; the leaves and branch apices are down-curved when the plants are dry



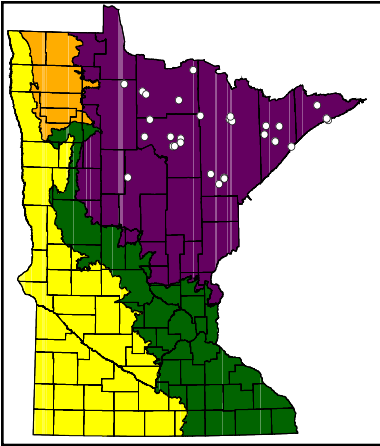


Bazzania TRILOBATA



a wetted plant seen from above (left) clearly shows the two parallel rows of imbricate and obliquely inserted leaves with truncated, three-toothed apices; such plants seen from below (above) displays the stolons (red arrows) and scalloped underleaves (blue arrows)

CLADOPODIELLA FLUITANS



Abundance: Frequent (F_{10}).

Habitat and field aspect: Frequent in northern poor fen, but also found occasionally in all other northern acid-peatland classes. Recorded from northern rich-fen water track. Most often the species is found as scattered stems among other peatland species, frequently within *Sphagnum* carpets or on low hummocks close to the local water table. Sometimes it colonizes and forms small, pure **black mats on bare peat** in bog and poor-fen mud bottoms.

Aid to Identification: Small plants (0.7- 2 mm wide) with **bilobed rectangular-rounded leaves**, usually quite distant along long, etiolated stems, dispersed among sturdy *Sphagnum* plants. The **leaf lobes are blunt** and there are small, narrow underleaves. **Stolons** (flagellate branches) **are common**.

Look-Alike Species: Only one other small leafy liverwort had obtuse bilobed leaves, *Gymnocolea inflata* (O/U₃).

Its leaves are shorter and more rounded, and there are no underleaves. *Gymnocolea inflata* also grows usually on wet rocks rather than in acid peatlands. Other small liverworts mixed in with *Sphagnum* are *Cephalozia* and *Cephaloziella* (F-U) species. These species are even smaller than *Cladopodiella fluitans* (often < 0.5 mm wide), and are often only seen when *Sphagnum* clones are studied under the stereoscope. Their leaves are also bilobed, but the lobes are sharply pointed, often connivent (points curved towards each other). *Nowellia curvifolia*, growing on rotten wood, is more similar in size to *Cladopodiella fluitans*, but its leaves are deeply concave and have two long, sharply-pointed (ciliate) leaf-lobe apices.

Associated Species: MesoHab: *Sphagnum magellanicum*, *Polytrichum strictum*, *Sphagnum rubellum*, *Sphagnum angustifolium*: Pop: *Sphagnum. angustifolium*, *Sphagnum magellanicum*, *Sphagnum fallax*.



dark patch colonizing a poor-fen mud bottom (flark) among *Drosera*, adjacent to a red *Sphagnum* clone

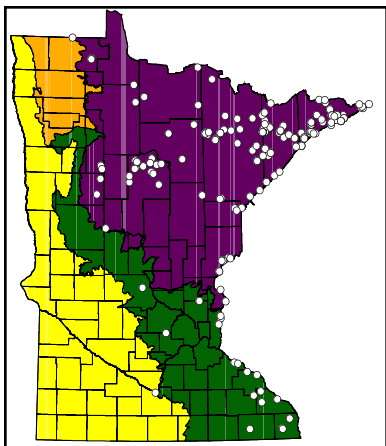


CLADOPODIELLA FLUITANS



often growing as upright, somewhat etiolated stems among *Sphagnum* plants; most of the leaves are much longer than wide, in contrast to those of *Gymnocolea inflata* or *Nowellia curvifolia*; the leaf-lobes are clearly obtuse but with a sharp sinus; narrow underleaves are visible on the ventral side

FRULLANIA EBORACENSIS



Abundance: Common (C_{20}).

Habitat and field aspect: Hardwood and conifer epiphyte found in all Minnesota's forest systems. Common in northern wet forest on ash and smooth-barked conifers, and in eastern dry to mesic hardwood and mixed fire-dependent forest. Frequent in mesic to wet northern and central hardwood forest, and northern and southern forested rich peatland (highest incidence with cedar-fir, mixed conifer, and tamarack, but also encountered in association with black spruce and alder). Recorded from mesohabitats such as southern terrace floodplain forest, and on shrubs or krummholz trees in northern transitional fen, wet meadow/carr, and southern moderate cliff. The species is an obligate epiphyte found on bark and twigs of living trees, sometimes quite high above the forest floor, rarely on coarse woody debris with bark still attached. On hardwood bark in its usual xerophytic microhabitat, the branches form a brown to black dendritic pattern; in highly mesic and shaded habitat the plants can be actually green.

Aid to Identification: One of the **smaller leafy liverworts**, but **forming often large patches**. Species of the genus *Frullania* are recognized by their complex leaf structure. This is not immediately obvious in the field, however, but when a few plants are scraped off, wetted, and studied with the handlens from the ventral side, the **conduplicate (bilobed) nature of the leaves, with ventral lobes transformed into inflated lobules, and small underleaves** can be seen. *Frullania eboracensis* is **dioicous**, and the **male plants quite a bit smaller**. The female plants are recognized by the **abundantly produced perianths**, the males by distinctly **elongated androecia**.

Look-Alike Species: The most reliable taxonomic distinctions among *Frullania* species are the position of the gametangia, and the structure of dorsal-lobe leaf cells, of lobules and their styli, and of underleaves. These need to be studied microscopically for critical identification. However, several species can be differentiated from *F. eboracensis* in the field: *F. selwyniana* (R_3) and *F. asagrayana* (O/U_3), restricted to the northeast, have a short row of dark-brown cells (ocelli) medially in the proximal part of the dorsal lobe. *Frullania bolanderi* (F_{11}), with a similar distribution as *F. eboracensis*, has numerous skeletal propaguliferous branches curving up and away from the leafy ones, easily observable in profile. Other species (F to U) occur mostly in the southeastern part of the state and have either relatively larger lobules or larger underleaves. Another small liverwort found



in the same micro- and mesohabitat and intermixed with *F. eboracensis* is *Radula complanata* (C/F_{14}). It is easily distinguished because of its light- to yellow-green color. *Porella platyphylla* (F_{20}) is a larger and a dark-green epiphyte, forming fan-shaped pendent mats.

clone of dendritically branched *F. eboracensis* with its typical dark-brown color



FRULLANIA EBORACENSIS

Associated Species: Mesohab: *Plagiomnium cuspidatum*, *Platygyrium repens*, *Callicladium haldanianum*; Microhab: *Callicladium haldanianum*, *Platygyrium repens*, *Hypnum pallescens*, *Plagiomnium cuspidatum*; Pop: *Platygyrium repens*, *Orthotrichum elegans*, *Radula complanata*, *Frullania selwyniana*.



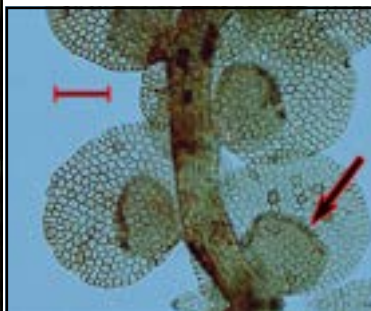
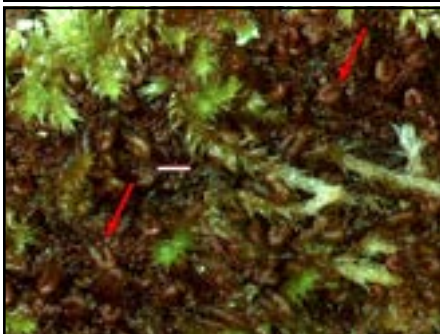
above: green population high on a fir tree in a humid and shaded spring-fen forest



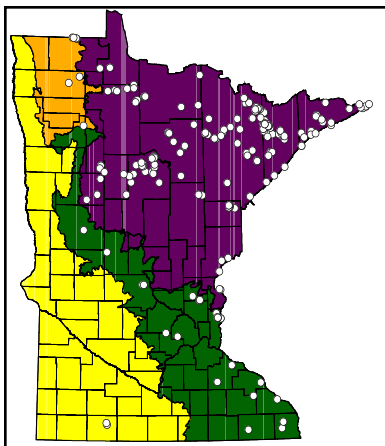
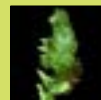
left: wet aspect of a small patch scraped off bark, showing the frequently overlapping dorsal lobes

lower left: *Frullania eboracensis*, notwithstanding its dioicous sexual arrangement, often produces abundant and elongate androecia on male clones

below: along the underside the inflated lobules (modified ventral lobes, black arrow) and underleaf (green arrow) are possible to see with the 20x handlens



LOPHOCOLEA HETEROPHYLLA

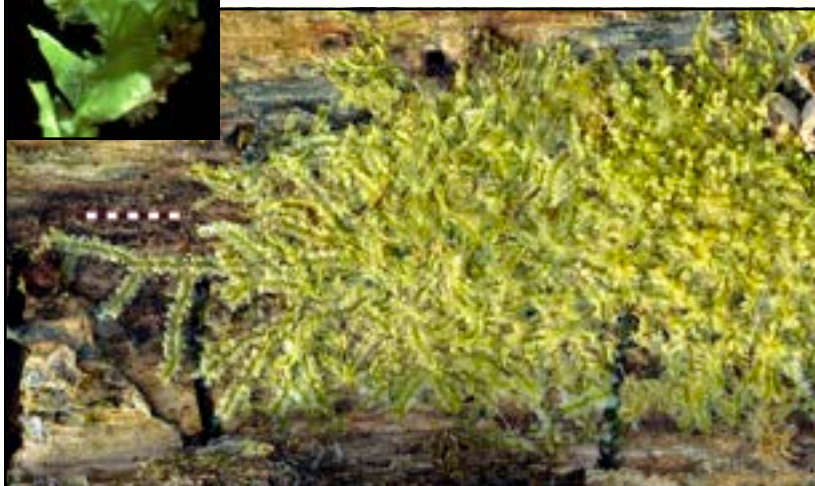
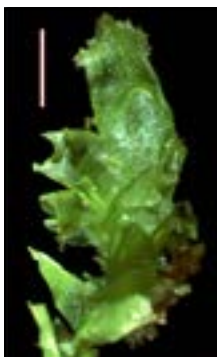


Abundance: Common (C₂₀).

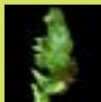
Habitat and field aspect: Common in most forested rich peatland classes, but occasional in northern cedar/fir swamp. Also common in most dry to mesic fire-dependent forest/woodland classes throughout the state. Frequent in dry to wet mesic hardwood forest and both open and forested acid peatland. Occasional in northern wet forest and southern floodplain forest. Found in both northern and prairie open rich peatland. Recorded from northern wet meadow/carr and southern open talus. The species is frequently growing on coarse woody debris and rotting wood, often in disturbed habitat. Also found on soil, peat banks, and as scattered plants among populations of other bryophytes. Extremely variable in aspect: the juvenile plants are quite different from the mature compact ones, and do not show the **characteristic dimorphism of the leaves**. Some clones, those on rotten wood, are easy to recognize with their long shoots and **terminal perianths**. Modifications growing in dense patches need to be confirmed using microscopic characters.

Aid to Identification: The **leaves are retuse to lobed with sharp points, often on the same stem**. The **perianth**, commonly present, is **trigynous and three-lobed at the mouth**. The **underleaves are bilobed with an additional lateral tooth** (confirm in lab with microscope), and the **rhizoids are clustered at the base of each underleaf**.

Look-Alike Species: A number of bilobed Jungermanniales have a similar field aspect: the most frequently encountered are *Jamesoniella autumnalis* (C/F₁₄), *Jungermannia leiantha* (O₄), *Chiloscyphus pallescens* (F₁₂), and *Geocalyx graveolens* (F₁₂). The first three species have rectangular to retused leaves, none clearly bilobed. Most similar to *L. heterophylla* is *Chiloscyphus pallescens*, but the plants are pale and translucent green. *Geocalyx graveolens* has sharply-toothed leaf-lobes, none retuse, and its darker stem contrast with the leaves which have a milky-white opaqueness to them. The shape of the underleaves and the position of stem rhizoids in relation to the underleaves are the best microscopic characters to differentiate these species. *Lophocolea minor* (F₁₂) is a much smaller species (approx. 0.5 mm wide), with prolific production of gemmae along the leaf margins. It is similar to juvenile *L. heterophylla* plants, which, however, do not produce gemmae. The numerous *Lophozia s.l.* species are less often encountered (F to U), and many of those species have 3 to more lobes



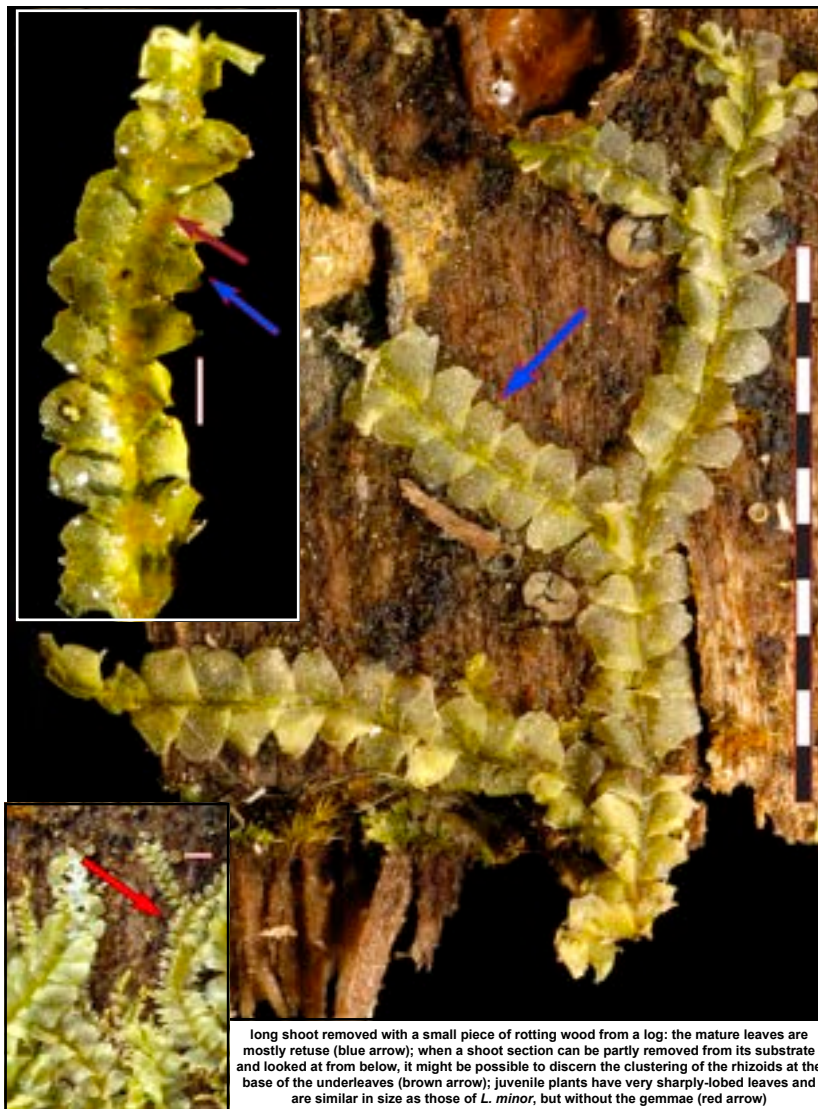
expanding clone on rotting log in mesic hardwood forest; above: perianth terminal on long branches



LOPHOCOLEA HETEROPHYLLA

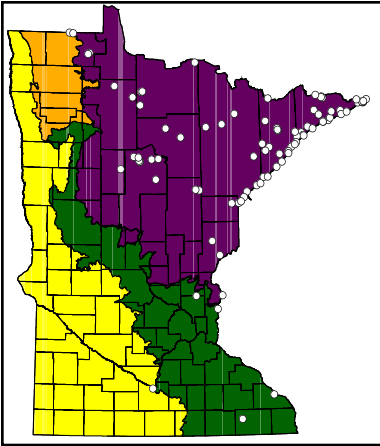
per leaf, gemmiferous branches, or terminal gemmiferous leaves. Those with consistently bilobed leaves also have abundant rhizoids along the entire length of the stem, not restricted to the insertion site of the underleaves. The bilobed *Harpanthus scutatus/drummondii* (O₃) has unlobed underleaves partly attached to the adjacent lateral leaves. Small stems might look very similar to those of the *Lophocolea* species, but are often gemmiferous at the apex. *Frullania* species, such as *F. bolanderi* (F₁₁) and *F. eboracensis* (C₂₀), have complex bilobed leaves but when attached to their substrate only show a rounded, not retuse, dorsal lobe. They are also usually brown or very darkly pigmented, and are epiphytes on living trees and shrubs.

Associated Species: MesoHab: *Callicladium haldanianum*, *Pleurozium schreberi*, *Aulacomnium palustre*, *Ptilidium pulcherrimum*, and *Platygyrium repens*; MicroHab: *Callicladium haldanianum*, *Plagiomnium cuspidatum*, *Hypnum pallescens*, *Platygyrium repens*, and *Brachythecium acuminatum*; Pop: *Callicladium haldanianum*, *Sanionia uncinata*, *Pleurozium schreberi*, *Ptilidium pulcherrimum*, and *Hypnum pallescens*.



long shoot removed with a small piece of rotting wood from a log: the mature leaves are mostly retuse (blue arrow); when a shoot section can be partly removed from its substrate and looked at from below, it might be possible to discern the clustering of the rhizoids at the base of the underleaves (brown arrow); juvenile plants have very sharply-lobed leaves and are similar in size as those of *L. minor*, but without the gemmae (red arrow)

PLAGIOCHILA ASPLENIODES



Abundance: Common/Frequent (C/F₁₇).

Habitat and field aspect: Common along Lake Superior rocky shore. Frequent in northern wet and very wet ash swamp and recorded from wet conifer forest. Also frequent in northern rich spruce and tamarack swamp, less so in cedar/fir and ash swamp. Occasional along other rocky river shore and on northern and southern cliff and talus. Found in northern mesic hardwood (cedar) forest, mesic mixed fire-dependent forest, and northern rich and extreme rich fen. About equally found as **scattered plants among large mat- and weft-forming bryophytes**, and as **large pure olive-green clones on rocks, forest floor**, and at the base of trees. When well-developed easily to recognize, but small scattered plants need to be confirmed with more diagnostic microscopic characters.

Aid to Identification: Well-developed plants are large (2-5 mm in width and up to 10 cm in length). They have a unique and distinctive **leaf insertion**: when removed they leave an **inverted 'J'-shaped or a '7'-shaped scar** on the stem. This insertion, producing the **bulging convex**

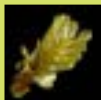
surface and the reflexed upper margin, causes the leaf to be shaped unlike the unlobed leaf of any other liverwort. **There are no obvious underleaves**. The best developed plants have **small teeth along the distal edge of the leaves**. Poorly developed plants are only recognized when the leaf insertion and other details can be studied, as the teeth are absent. *Plagiochila porelloides* is not recognized anymore as a separate taxon.

Look-Alike Species: Many entire-leaved liverworts might look similar to depauperate specimens of *P. asplenioides*. However, they have either a somewhat truncate to retuse leaf apex (*Jamesoniella autumnalis*, C/F₁₄, *Jungermannia leiantha*, O₄, and *Chiloscyphus pallescens*, F₁₂), or are distinctly bilobed, such as *Lophocolea heterophylla* (C₂₀) and *Geocalyx graveolens* (F₁₂). All these species are smaller than well-developed *P. asplenioides*. *Porella platyphylla* (F₂₀) is a large olive-green liverwort similar in size to *P. asplenioides*, and growing on tree bark, but usually high up on tree trunks. It has, however, bilobed leaves (a small ventral lobe tucked away underneath a large dorsal one), and large underleaves.

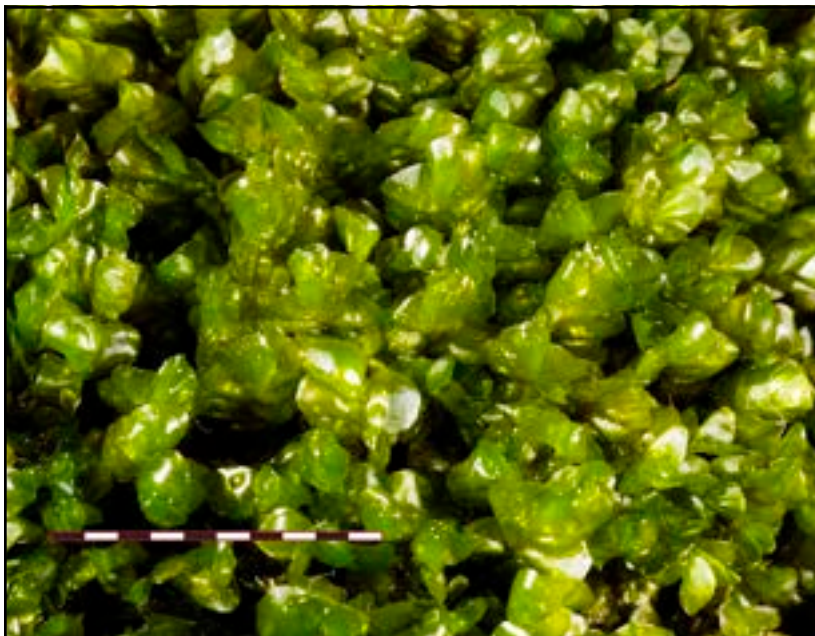
Associated Species: MesoHab: *Callicladium haldanianum*, *Plagiommium cuspidatum*, *Hypnum lindbergii*, *Tetraphis pellucida*; Microhab: *Callicladium haldanianum*, *Hypnum pallescens*, *Plagiommium cuspidatum*, *Platygyrium repens*; Pop: *Climacium dendroides*, *Sanionia uncinata*.



large clone in riparian habitat, on rock in side channel of a creek with intermittent water flow



PLAGIOCHILA ASPLENIOIDES

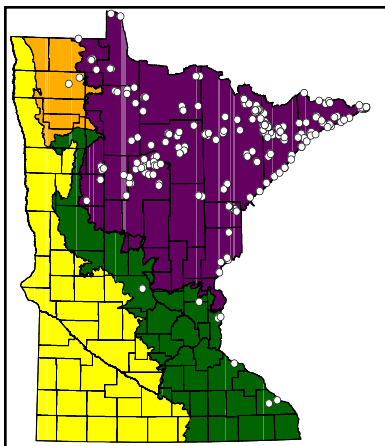


above and right: large plants with leaves convex-bulging toward the dorsal side (when dry even more pronounced), lower margins often recurved

right and below right: the apex of the stem has down-curved leaves, but a large, upright perianth; the dorsal part of the leaf insertion is long-decurrent (red arrow); better developed plants have a denticulate distal leaf margin



PTILIDIUM PULCHERRIMUM



Abundance: Common (C_{18}).

Habitat and field aspect: Common in dry to mesic northern and central fire-dependent forest or woodland, and in northern forested rich peatland. Frequent in acid peatland, mainly in northern spruce bog and poor conifer swamp. Occasional in southern and northwestern rich conifer swamp, in dry to mesic hardwood forest, northern wet forest and on krummholz Lake Superior rocky shore. Recorded from open rich-fen and northern mesic mafic-cliff sites. A northern xerophytic species at the base of coniferous trees. Occasionally on hardwood bark or felsic rock. The species forms dry, usually rusty-brown to matte green, crusty mats, which, when thin, are hard to remove without knife or spatula.

Aid to Identification: The handlens will immediately reveal the **ciliate (frilly) leaf edges**. The larger dorsal leaves of this small liverwort are lobed, but **long and slender cilia** hide their shape effectively. Frequently patches are found with **long-lasting perianths**, structures protecting the female gametangia or archegonia.

Look-Alike Species: *Ptilidium ciliare* (F_{10}) is larger and easily removed from its substrate (weft rather than mat growth form). Other liverworts in Minnesota with ciliate leaves: *Blepharostoma trichophyllum* (F_{11}), nearly microscopically small, has leaves completely reduced to cilia; *Trichocolea tomentella* (R_3), a state-listed species, grows in large bright-green, rather than brown-green, felt-like wefts in depressions in cedar swamps.

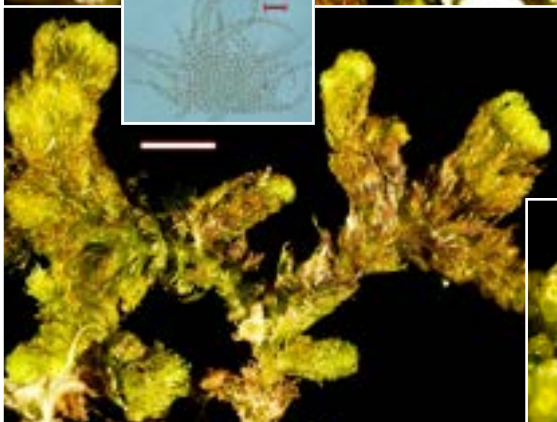
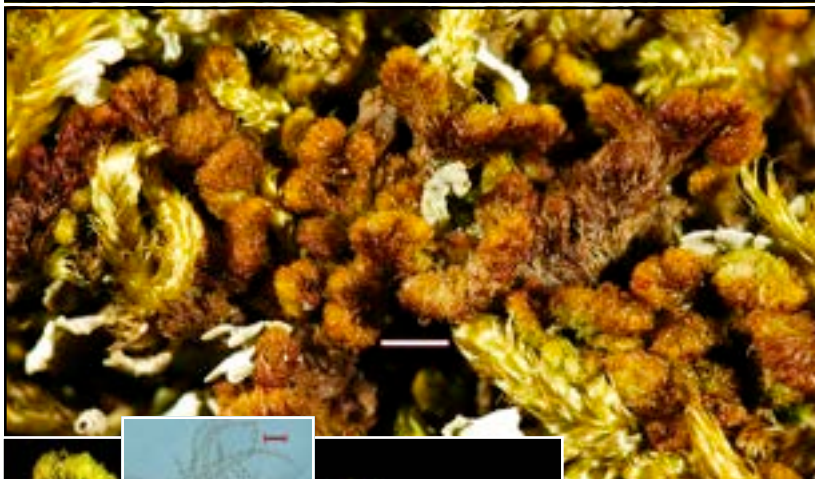
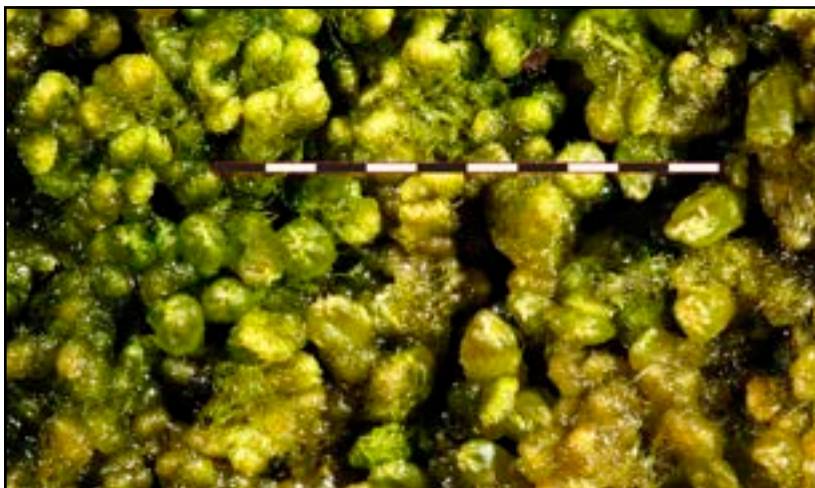
Associated Species: Mesohab: *Pleurozium schreberi*, *Callicladium haldanianum*, *Dicranum flagellare*, *Aulacomnium palustre*; Microhab: *Callicladium haldanianum*, *Plagiomnium cuspidatum*, *Hypnum pallescens*, *Platygyrium repens*; Pop: *Hypnum pallescens*, *Dicranum flagellare*, *Callicladium haldanianum*.



below: tightly adhering mats on the rough bark at the base of a jack pine; above: exceptionally also on felsic rock



PTILIDIUM PULCHERRIMUM



above: tightly enrolled leaves with strongly fringed margins (ciliate, see inset to the left), green, or the most xerophytic forms, fuscous-brown

below: persistent perianths are commonly found

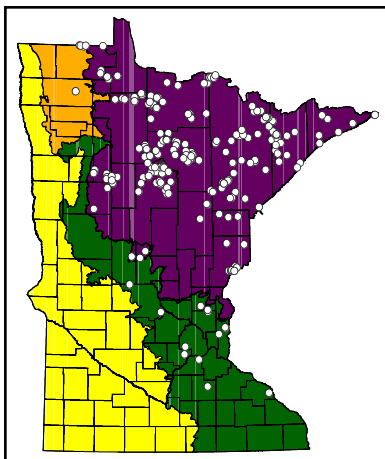




SPHAGNUM

SPHAGNUM ANGUSTIFOLIUM

(SECTION CUSPIDATA)



Synonym: *Sphagnum recurvum* var. *tenu*.

Abundance: Common (C₁₀).

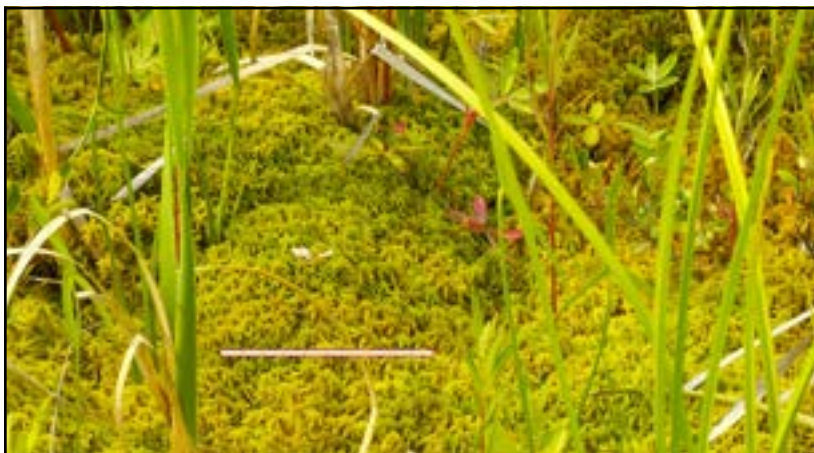
Habitat and Field Aspect: Minnesota's most common *Sphagnum* species, in acid and forested rich peatland, but also in open rich peatland, wet forest, woodland, wet meadow, and marsh, wherever there is colonization by *Sphagnum*. Dominant in depressions in open and forested bog, poor fen, shore fen, and rich spruce swamp. Frequent in tamarack and occasional in cedar and alder swamp. Forming soft, loose carpets or extensive lawns surrounding hummocks of other species. Rarely forming low hummocks itself. Sometimes found as dry, crusty carpets among forest-floor litter. The carpets, even those in depressions, dry out quickly before the nearby hummocks, and their white aspect contrasts sharply with the still wet plants surrounding them.

Aid to Identification: *Sphagnum angustifolium* is medium-sized with **mostly flat, stellate, green to yellowish brown, capitula**. Scattered plants among other sphagnum, growing higher up along the sides of hummocks, or plants on the drier woodland forest floor have less of

a stellate appearance, with larger, more hemispherical capitula. There is **no obviously enlarged terminal bud** within the capitulum. When wet the branch leaves are often 5-ranked, and **when dry, they are sharply recurved with wavy margins**. There is a **pinkish tint along the basal parts of the spreading branches**, observable through the wet leaves. Most characteristic is a **short stack of paired pendent branches, visible in profile between the arms of the stellate capitulum**.

Look-Alike Species: No other *Sphagnum* has this obvious stack of young, paired pendent branches, except for the sister species within the *S. recurvum* aggregate: *S. fallax* (F₁₄) and *S. flexuosum* (O.). These can only be differentiated from *S. angustifolium* by their larger and often pointed stem leaves. In *S. angustifolium* the stem leaf is short (<0.8 mm), obtuse, and appressed to the stem, often flipped-over downward. Other species of the section *Cuspidata*, lacking paired pendent branches, grow as aquatics and are green (*S. viride*, U₃) or dark brown (*S. majus*, F₁₀), or, as in the case of *S. riparium* (O/U₁), have a distinctive rent in the stem-leaf apex. Species of *Sphagnum* from other sections that have a similar field aspect are *S. wulfianum* (C/F₁₄), section *Polyclada*, with spherical capitula and a strong, woody and dark-brown stem) and *S. girgensohnii* (F₁₃), section *Acutifolia*, with a stiffly stellate appearance, always green, even when dry).

Associated Species: Mesohab: *Sphagnum magellanicum*, *Aulacomnium palustre*, *Polytrichum strictum*, *Pleurozium schreberi*, *Callicladium haldanianum*, *Sphagnum fuscum*; Pop: *Sphagnum magellanicum*, *Aulacomnium palustre*, *Pleurozium schreberi*, *Polytrichum strictum*, *Straminergon stramineum*.



aspect of wet carpet



SPHAGNUM ANGUSTIFOLIUM



drying carpet, several plants turning white, in a hollow between hummocks that are still wet

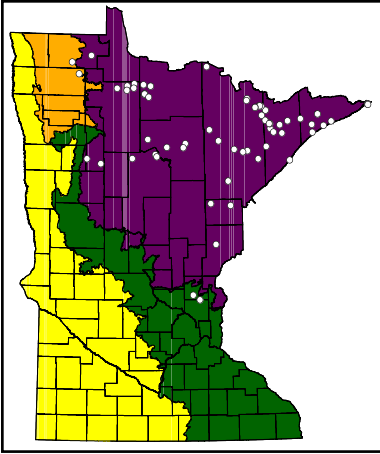


above left: stack of paired pendent branches between the arms of the stellate capitulum and pinkish branch bases; inset: small, stubby stem leaves flipped downward along a stained stem

above right: a drying plant with branch leaves turning recurved-undulate

right: stellate capitulum

SPHAGNUM CAPILLIFOLIUM (SECTION ACUTIFOLIA)



Abundance: Common (F₁₄).

Habitat and Field Aspect: Frequent in northern poor conifer swamp. Occasional in northern rich spruce swamp and spruce bog, and poor fen. Recorded from northern cedar/fir swamp and Lake Superior Rocky shore. In open peatland the species grows lower down on tall *Sphagnum* hummocks or forms **moderately high hummocks** by itself, characteristically **variegated green-red with densely packed, bumpy capitula**; in forested mesohabitat it can form small dry hummocks of a firm and stiff aspect, usually green or yellow-green with just a tint of red.

Aid to Identification: Typically, the **capitulum is domed** in open-grown modifications, but can be nearly **hemispherical** in shaded-forest forms. There is no visibly enlarged terminal bud, and its **branch leaves are not 5-ranked**. The **stem leaf**, best studied after removing the capitulum and looking (20x handlens) at the remaining crown of leaves, **is long-oblong** with a **distinct triangular apex**.

Look-Alike Species: *Sphagnum capillifolium* is frequently associated with *S. magellanicum*, which is, however, a red species of much larger size with cucullate branch leaves and stubby branches in the capitulum. Of the 'small-red *Acutifolia*' there are quite a number of look-alikes: the most frequently encountered are *S. warnstorffii* (C₁₅), *S. russowii* (F₁₁), and *S. rubellum* (C₃₄). *Sphagnum warnstorffii*, with branch leaves distinctly 5-ranked, is often tinted purplish, and found only in highly minerotrophic peatlands. *Sphagnum russowii* shows a small terminal bud and its stem-leaf apex is rounded and notched rather than triangular. *Sphagnum rubellum* is highly similar to *S. capillifolium*, often considered only as a subspecies or variety of *S. capillifolium*. It has only recently been differentiated from *S. capillifolium* as a species, and might be more common than presently recorded in the state. Typically it has a flatter capitulum and its branch leaves are often 5-ranked and somewhat secund. It usually grows lower down near the water table as wet carpets and lawns, less densely packed than *S. capillifolium*. There are a number of other, more rare, small-red *Acutifolia* sphagna (see *Sphagnum rubellum*), so laboratory identification is necessary for a positive and critical ID.

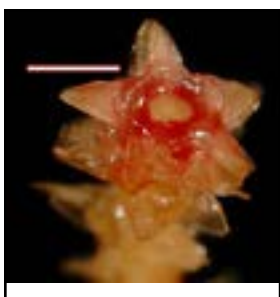
Associated Species: Mesohab: *Pleurozium schreberi*, *Aulacomnium palustre*, *Sphagnum angustifolium*, *Sphagnum magellanicum*, *Sphagnum fuscum*, *Dicranum polysetum*, *Ptilidium pulcherrimum*, *Polytrichum strictum*: Pop: *Pleurozium schreberi*, *Sphagnum magellanicum*, *Sphagnum angustifolium*, *Polytrichum strictum*, *Aulacomnium palustre*, *Sphagnum fuscum*.



small green to variegated green-red plants, with hemispherical capitula, forming large hummocks or extensive carpets



SPHAGNUM CAPILLIFOLIUM



above and middle: rounded, non-stellate capitula in a bumpy, dense carpet, variegated red-green

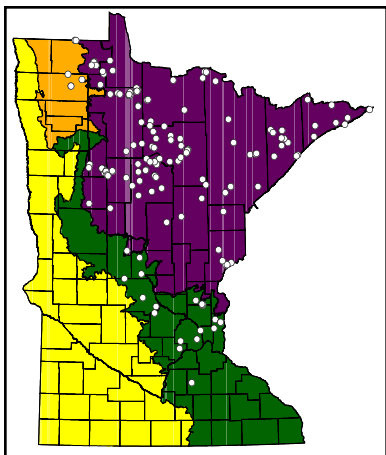
left: stem leaf with triangular-shaped apex

right: hemispherical capitula



SPHAGNUM CENTRALE

(SECTION SPHAGNUM)



Abundance: Common (C₁₇).

Habitat and Field Aspect: Common in forested rich peatland: northern alder carr and swamp, and rich conifer and tamarack swamp. Frequent in open poor, transition, or rich fen. Occasional in shrub shore fen, wet ash swamp, and poor conifer swamp. Recorded from wet forest and wet cliff. *Sphagnum centrale* forms irregular carpets or low hummocks, usually draped over woody debris, or low mounds surrounding the base of shrubs. The plants are only loosely packed and rarely form deep peat in non-woody peatland.

Aid to Identification: Plants with **large capitula**. **Branch leaves** of the young spreading branches **distinctly cucullate**; with 20x magnification, it is possible to observe **small teeth on the abaxial surface of their hood-shaped apex**. The plants are **typically greenish-white in dense shade, but yellow-brownish, sometimes with a pinkish tint, in open habitat**. The **stem is nearly always brown or black, even in the dense shade forms**. Typically, **mature spreading branches curve downward, are strongly elongated, and end in narrow, fine points**.

Look-Alike Species: In its usual mesohabitat the only other *Sphagnum* species with a similar large capitulum is *S. squarrosum* (C/F₁₈). Both *S. squarrosum* and *S. centrale* form whitish-green mounds or small, draping carpets, supported by woody debris or low shrubs. However, *S. squarrosum* is easily recognized by its spiky appearance, caused by its squarrose-recurved and sharply pointed branch leaves, in contrast with the rounded and cucullate leaves of *S. centrale*. Green modifications of *S. magellanicum* (C₁₉) and *S. papillosum* (F₁₆) — the only other two Minnesota species of the section *Sphagnum* which is characterized by the cucullate leaves — are hard to differentiate from *S. centrale*. *Sphagnum magellanicum* co-occurs with *S. centrale* in about half of the ecotopes. Co-occurrence with *S. papillosum* is far more rare. *Sphagnum magellanicum* nearly always shows some small flecks of red pigment in its translucent stem when wet, and *S. papillosum* usually has shorter branches, ending in stubby points. However, critical identification of purely green modifications is only possible by studying microscopic stem-hyalodermis, and branch- and stem-leaf characters.

Associated Species: Mesohab: *Aulacomnium palustre*, *Pleurozium schreberi*, *Callicladium haldanianum*, *Sphagnum warnstorffii*, *Sphagnum angustifolium*, *Sphagnum magellanicum*, *Plagiomnium ellipticum*; Pop: *Sphagnum angustifolium*, *Aulacomnium palustre*, *Sphagnum warnstorffii*, *Pleurozium schreberi*, *Sphagnum teres*, *Polytrichum strictum*, *Straminergon stramineum*.



Sphagnum centrale most commonly forms loose hummocks at the base of shrubs, yellow-brown in exposed
inset: light-green in shaded habitat



SPHAGNUM CENTRALE



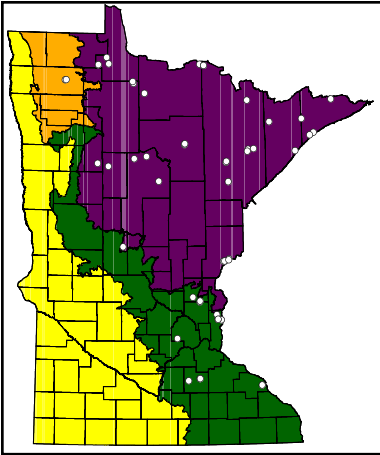
small carpet supported by woody debris

plant with large capitulum; lower on the stem with long trailing and sharply pointed spreading branches (white arrows); stem color dark-brown to black (blue arrow)



capitulum without enlarged apical bud and elongated branches with cucullate leaves

SPHAGNUM FIMBRIATUM (SECTION ACUTIFOLIA)



Abundance: Frequent (F₁₆).

Habitat and Field Aspect: Common in acid and circum-neutral forested or shrubby peatland, wet meadow, and carr. Found in alder swamp, and in the lagg surrounding bogs and poor fens. Forming small hummocks or larger clones, often with an untidy-looking aspect, the plants growing over woody debris and against stems of shrubs and small trees. The weakly stemmed plants form green or yellowish-green carpets and are usually loosely packed, rarely exhibiting a smooth surface.

Aid to Identification: **Small and slender plants** with a **conspicuous terminal bud**, **without any trace of reddish pigment**, and with **pale stems**. The **branch leaves are not five-ranked**. Commonly producing sporophytes. The best way to confirm the identification of *S. fimbriatum* in the field is checking the structure of the stem leaf: remove the capitulum of a single plant and study the crown of stem leaves remaining at the tip of the broken stem with a 20x handlens. A complete **fringe of lacerate stem-leaf apices and margins** should be visible.

Look-Alike Species: When confirmed as above no other

species can be confused with *S. fimbriatum*. Other sphagna, also often green and with a similar field aspect, are *S. angustifolium* (C₁₉), *S. girgensohnii* (F₁₃), and *S. teres* (C/F₁₉). *Sphagnum angustifolium* is sometimes quite small and similar in size to *S. fimbriatum*, but in healthy clones the plants are much more robust. It has paired pendent branches protruding between the arms of a stellate capitulum, and no conspicuous terminal bud. When dry, its branch leaves are wrinkled and their tips recurved. Both *S. girgensohnii* and *S. teres* are more robust plants, which in the field appear a lot more firm and regularly spaced than *S. fimbriatum*, and they form large, smooth carpets. The stem leaves of *Sphagnum girgensohnii* are fibrillose only along the top of the apex, and *S. teres* is often brownish. The other small sphagna in Minnesota have either a trace of red or orange pigment (often in the stem cortex) or are distinctly brownish with a dark stem. Several also have five-ranked branch leaves, or twisted branches.

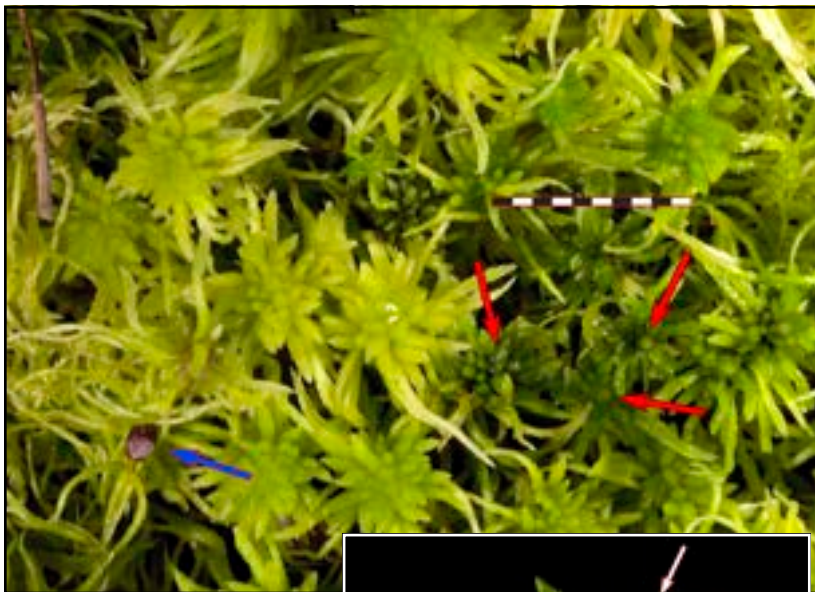
Associated Species: Mesohab: *Aulacomnium palustre*, *Sphagnum magellanicum*, *Sphagnum angustifolium*, *Callicladium haldanianum*, *Lophocolea heterophylla*, *Sphagnum centrale*; Pop: *Sphagnum magellanicum*, *Aulacomnium palustre*.



small hummock of *Sphagnum fimbriatum* with typical untidy field aspect

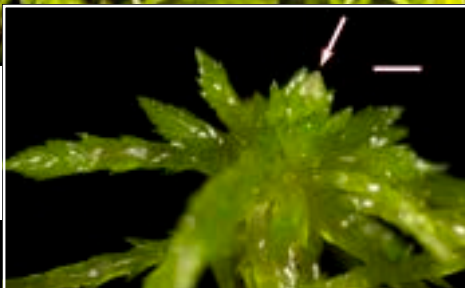


SPHAGNUM FIMBRIATUM



above: mixed patch of plants of *Sphagnum fimbriatum* (small, darker green) and *S. angustifolium* (larger, yellow green); an older sporophyte is indicated by the blue arrow;

right: the *S. fimbriatum* capitulum has an enlarged terminal bud



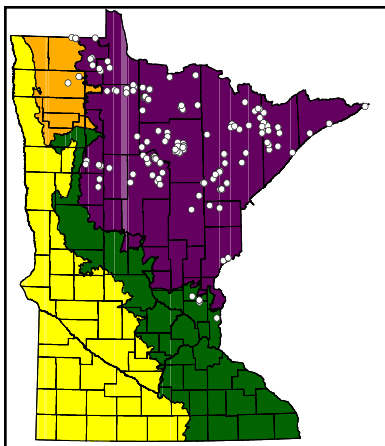
plants often with sporophytes, here an older one from lower down along the stem on a strongly elongated pseudopodium



fringed stem-leaf crown on top of broken stem after the capitulum is removed (inset close-up)



SPHAGNUM FUSCUM (SECTION ACUTIFOLIA)



Abundance: Common (C₁₄).

Habitat and Field Aspect: Common in northern acid peatland, mostly in open bog and open poor fen. Frequent in spruce bog and forested poor fen. Occasional in patterned forested rich peatland, preferentially associated with tamarack, rather than with black spruce, cedar, or fir. Recorded from open rich peatland. In open acid peatland *Sphagnum fuscum* often forms large mounds or tall hummocks. Open-grown *S. fuscum* hummocks are brown and the plants are very small with densely packed capitula in a smooth carpet, surrounding small woody stems of *Chamaedaphne* or other ericads. In shaded mesohabitat the species forms isolated small hummocks or is scattered among plants of other species of *Sphagnum* that form the taller hummocks. In minerotrophic peatland the hummocks occur on elevated peat islands — in patterned water tracks on strings — isolated from the surface water by peat build-up.

Aid to Identification: **Brown in exposed habitats**, sometimes olive-green in dense shade under trees. **Stems are always brown to black**, even in green shade modifica-

tions. The capitula are small (often far less than 1 cm in diameter) without an enlarged terminal bud. The **stem leaf is long-oblong, with a rounded apex, and upright along the stem**.

Look-Alike Species: In Minnesota no other small *Sphagnum* species forms tall and brown, smooth-surfaced hummocks with such dense packing of the plants. However, there is one related species in the section *Acutifolia* that also has a brown cast. When dry this species, *S. subfulvum* (O₉), has a metallic sheen and usually more pointed stem leaves. I have not seen this species forming other than low hummocks or loose carpets close to the water table in minerotrophic mesohabitat. Brown *Sphagnum* species of other sections are larger plants, such as *S. majus* (F₁₀₇, section *Cuspidata*), *S. riparium* (O/U₉, section *Cuspidata*), and *S. teres* (C/F₁₃₉, section *Squarrosa*). They grow closer to the water table, and both the latter species are recognized by the presence of an enlarged terminal bud. *Sphagnum papillosum* (F₁₆, section *Sphagnum*) can form extended carpets of tightly packed and small plants in open poor-fen lawns, but its branch leaves are cucullate.

Associated Species: Mesohab: *Sphagnum magellanicum*, *Polytrichum strictum*, *Aulacomnium palustre*, *Sphagnum angustifolium*; Pop: *Sphagnum magellanicum*, *Polytrichum strictum*, *Sphagnum angustifolium*, *Sphagnum capillifolium*.



top of tall hummock, formed by small compact *S. fuscum* plants in open bog



SPHAGNUM FUSCUM



other commonly associated species are *S. capillifolium* (small red), *S. magellanicum* (large red on top), and *S. angustifolium* (larger yellowish plants on left)

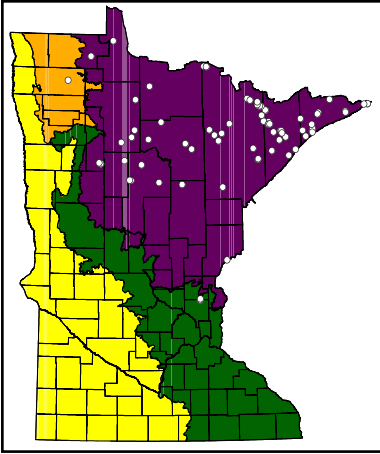


above: small capitulum without obvious terminal bud

left: brown stem always distinctive

below: plants often branch dichotomously, creating densely packed clones

SPHAGNUM GIRGENSOHNII (SECTION ACUTIFOLIA)



Abundance: Frequent (F₁₃).

Habitat and Field Aspect: Frequent in forested rich peatland, mainly cedar/fir and rich-spruce swamp. Occasional as a pioneering paludifying species in fire-dependent mesic coniferous or mixed forest and woodland, and in forested acid swamp. Recorded along the shaded margins of circumneutral transitional fen and shore fen, and in alder carr. The species grows in flat and green carpets or forms **expansive low mounds** surrounding trees.

Aid to Identification: **Medium to large, robust, and wiry plants with stiff, star-shaped and flat capitula, and far-extending spreading branches. Light green to yellowish green, and stems always green.** The capitulum shows an **enlarged terminal bud**. The **branch leaves are straight, both wet and dry**. Only a **single pendent branch** is visible per fascicle. To confirm the identification of a *S. girgensohnii* specimen check the structure of the stem leaf. This is done by removing the capitulum and studying the crown of stem leaves remaining at the tip of the broken stem: the **stem leaves have a fibrillose apex, but the sides are entire**.

Look-Alike Species: *Sphagnum teres* (C/F₁₉) is the species most commonly confused with *S. girgensohnii*. However, *S. teres* is usually brownish — always with a dark stem — and grows in more exposed microhabitat. Its branch leaves, on fascicles lower along the stem, are often squarrose-recurved rather than straight. Stem leaves are quite different: long-lingulate and often with an abruptly truncated apex in *S. teres*, but short and wide, with a distinctly fibrillose and gradually rounded apex in *S. girgensohnii*. With a 20x hand lens it might be possible to observe a lattice-like network of large hyaline cells at the base of the stem leaf of *S. girgensohnii*. Robust yellow-green plants of *S. angustifolium* (C₁₃) might also look similar to *S. girgensohnii*, but their capitula are more domed and less obviously star-shaped. In addition, it has paired pendent branches in each fascicle, rather than a single one as in *S. girgensohnii*. *Sphagnum russowii* (F₁₁) has a similar field aspect as *S. girgensohnii*, but has a less obvious terminal bud and nearly always some red pigment in either branches or stem. *Sphagnum wulfianum* (C/F₁₄) forms rough-surfaced carpets and its capitula are nearly spherical.

Associated Species: Mesohab: *Pleurozium schreberi*, *Callicadium haldanianum*, *Ptilidium pulcherrimum*, *Dicranum flagellare*, *Tetraphis pellucida*; Pop: *Sphagnum angustifolium*, *Sphagnum magellanicum*, *Aulacomnium palustre*, *Pleurozium schreberi*.



wiry green plants in a smooth carpet



SPHAGNUM GIRGENSOHNII



capitula distinctly star-shaped and with enlarged terminal buds

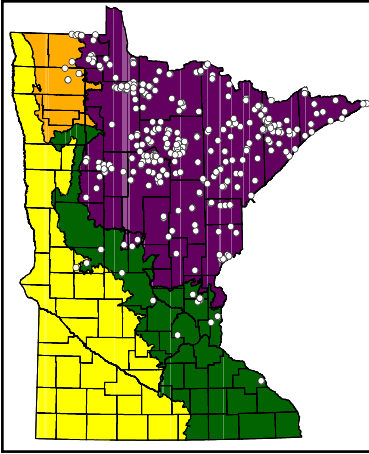


terminal bud protruding (red arrows), long decurved spreading branches (white) and single pendent branch per fascicle (blue)



stem-leaf crown with stem-leaf apex fibrillose

SPHAGNUM MAGELLANICUM (SECTION SPHAGNUM)



Abundance: Common (C₁₉).

Habitat and Field Aspect: Common in acid peatland in both open and forested poor fen and bog. Frequent in open and forested rich peatland. Occasional in mesic mixed woodland, rich conifer swamp, and wet ash swamp and meadow/carr. Recorded from hardwood and pine woodland in small depressions. In open mires the species forms **loose carpets and low hummocks**, in forested bog often **hummocks of medium height**. Small high hummocks can be found near the base of trees. There the green plants are small and compacted together in a dense and brittle patch.

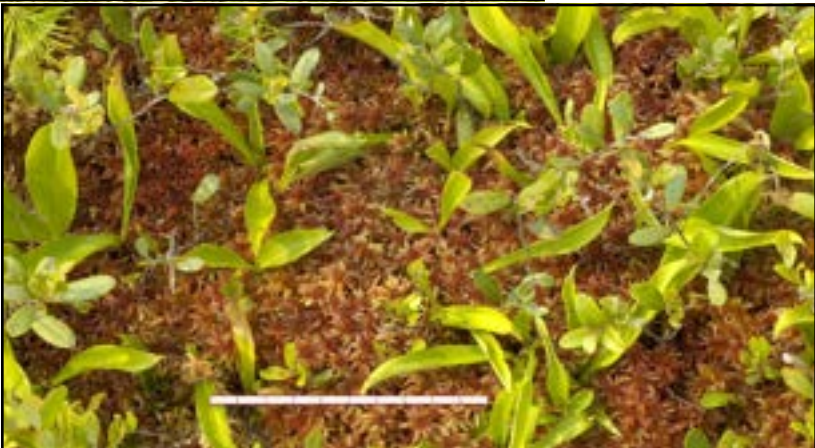
Aid to Identification: *Sphagnum magellanicum* belongs to the section *Sphagnum*, characterized by large plants with **stubby branches and rounded, cucullate leaves**. With the 20x handlens you can observe **small teeth on the abaxial surface of the branch-leaf apex**. The species produces without fail **red or pink pigmentation** in open habitat. Even plants of shaded, green populations have nearly always a **pink or reddish translucent stem**, visible with back lighting when wet.

Look-Alike Species: However, in the unlikely event of a completely green stem, only microscopic examination can confirm a field identification and differentiate the species from *S. centrale* (C₁₇) and *S. papillosum* (F₁₆), the other two Minnesota species in the section *Sphagnum*.



All other *Sphagnum* species have pointed branch leaves, but those of *S. subsecundum* (C/F₁₅) can be quite inrolled and then appear rounded. This species is, however, found close to the water table growing in small clones or as carpets in the more minerotrophic habitat of intermediate fens.

Associated Species: Mesohab: *Sphagnum angustifolium*, *Aulacomnium palustre*, *Polytrichum strictum*, *Pleurozium schreberi*, *Sphagnum fuscum*, *Callicladium haldanianum*; Pop: *Sphagnum angustifolium*, *Aulacomnium palustre*, *Polytrichum strictum*.



below: reddish carpet in open poor fen; above: green hummock in forested bog near base of black-spruce tree



SPHAGNUM MAGELLANICUM



Sphagnum magellanicum (large red) plants mixed with those of *S. russowii* (small red) and *S. angustifolium* (larger green-yellow-brown)

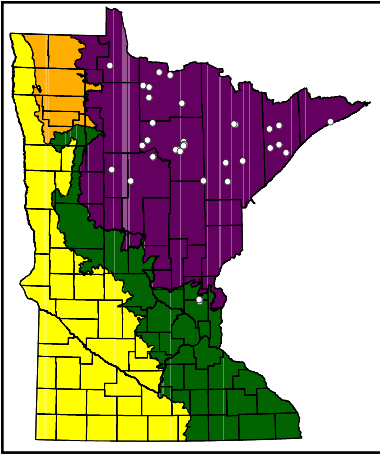


left: even on the compact green plants of shade forms observe the reddish stem behind the translucent pendent branches (white arrow)



red capitulum with stubby young branches and cucullate branch leaves with small teeth at the apex (blue arrow)

SPHAGNUM MAJUS (SECTION *CUSPIDATA*)

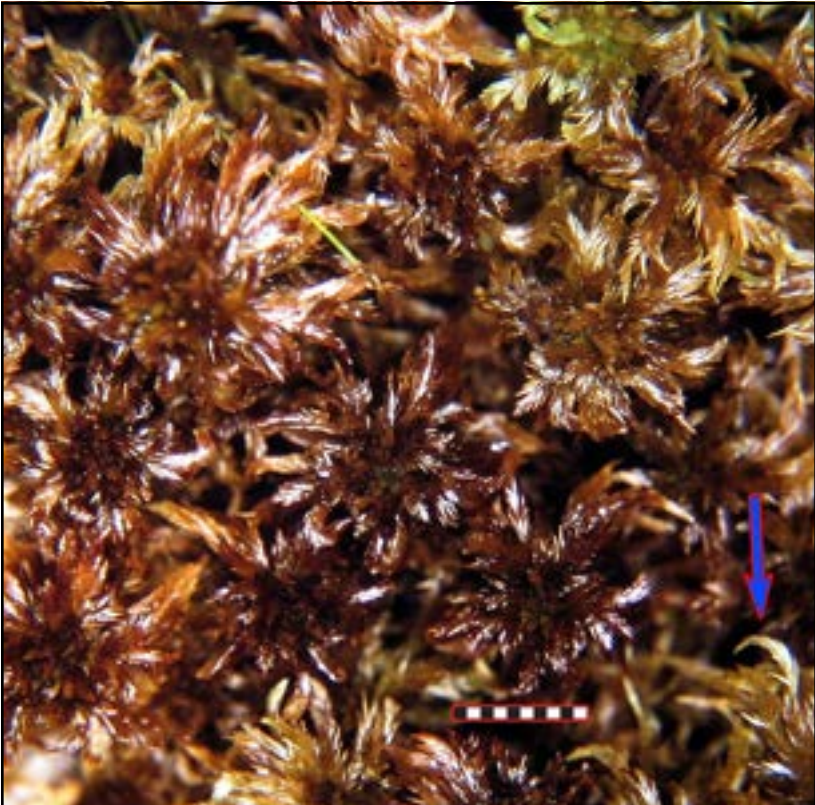


Abundance: Frequent (F₁₀).

Habitat and Field Aspect: Nearly completely restricted to open northern poor and transitional fen. Occasional in poor-tamarack swamp, spruce bog, and a narrow open rich-fen water track between two ovoid bog islands. Recorded from northern wet meadow/carr. Growing **half submerged** in water-logged depressions, hollows, and flarks in open peatland, forming **expansive soft and yellow-brown to dark-brown carpets** that usually don't support a person's weight.

Aid to Identification: **Golden- to dark-brown in color.** **Medium or large plants** with flat, **stellate capitula**, the **spreading branches of the radii often laterally curved.** **Stems weak** and carpets only supported by the ambient water. **When dry the plants do not turn papery white but stay shiny.** The **leaves on the spreading branches are long and narrow, often subsecund, and strongly undulate when dry.** **Terminal bud somewhat enlarged**

and the **young pendent branches usually single**, not grouped in obvious pairs.



golden-brown, stellate capitula with laterally curved branches



SPHAGNUM MAJUS

Look-Alike Species: *S. majus* is darker than the exposed and semi-aquatic yellow-brown modifications of *S. angustifolium* (C_{10}) and its slightly more pigmented look-alike, *S. fallax* (F_{14}). Both these species are quite common in mesohabitat similar to that of *S. majus*. However, *S. majus* plants stay dark and glossy on drying. Its pendent branches between the radii of the stellate capitula do not form a stack of paired branches, and the older branches are somewhat distant from the stem rather than hugging it. The branch leaves are also significantly more elongate than those of *S. angustifolium* and *S. fallax*. *Sphagnum cuspidatum* (U_1) and *Sphagnum viride* (U_2) are more rare in Minnesota, and usually green: critical identification and differentiation from *S. majus* needs microscopic study. In addition, differentiating characters between the two subspecies *S. majus* subsp. *majus* and *S. majus* subsp. *norvegicum* have to be studied with the microscope. The taxonomic separation made between these two subspecies in Minnesota is still too recent to be able to correlate with their field aspect and habitat preferences, or to provide separate distribution maps. The subspecies *norvegicum* appears to be the more common one of the two.

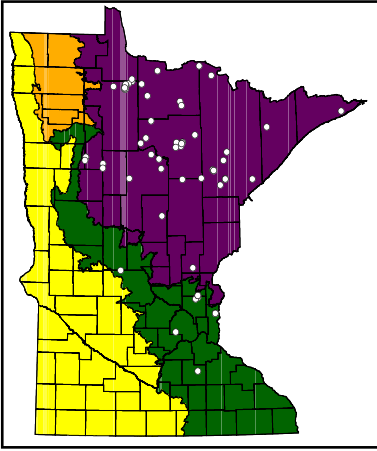
Associated Species: Mesohab: *Sphagnum magellanicum*, *Polytrichum strictum*, *Sphagnum angustifolium*, *Sphagnum rubellum*, *Sphagnum fuscum*, *Sphagnum papillosum*, *Aulacomnium palustre*, *Cladopodiella fluitans*, *Sphagnum fallax*, *Sphagnum subsecundum*; Pop: *Cladopodiella fluitans*, *Sphagnum magellanicum*.



branch leaves are elongated, subsecund, shiny and undulate when dry; pendent branch single

SPHAGNUM PAPILLOSUM

(SECTION SPHAGNUM)



Abundance: Frequent (F₁₆).

Habitat and Field Aspect: In acid peatland an indicator for minerotrophic influence: frequently found in northern transitional and poor fen, but rare in ombrotrophic bog. Occasional in open and forested rich peatland. The species forms **expansive smooth carpets** encroaching on the peat-bottom vegetation of hollows and flarks in patterned water tracks. It often forms circular islands in fen water tracks which later get colonized by trees. In open mesohabitat its **golden-brown color** and **densely packed capitula** are quite distinctive.

Aid to Identification: *Sphagnum papillosum* belongs to the section *Sphagnum* and it has its diagnostic **cucullate branch-leaf apices with small teeth (squamae) extending from their abaxial surface**, visible with backlighting and a 20x handlens. The **plants are golden-yellow to dark brown, the medium-sized capitula (± 1 cm in diameter) formed by short stubby branches**. Shade modifications are golden-yellow to somewhat pinkish, but the **stems are still distinctly dark-brown to black**.

Look-Alike Species: The plants are usually smaller than those of the other Minnesota species of the section *Sphagnum*, *S. magellanicum* (C₁₉) and *S. centrale* (C₁₇). Its spreading branches are not as drooping, elongated, and sharply pointed as those of *S. centrale*. Entirely green, deep-shade modifications of *S. papillosum*, *S. magellanicum*, and *S. centrale* need to be checked microscopically. Medium-sized plants of *Sphagnum* species with similar brown coloration and found in open poor-fen habitat are *S. teres* (C/F₁₉, section *Squarrosa*) and *S. riparium* (O/U, section *Cuspidata*). These species are differentiated from *S. papillosum* by their pointed branch leaves. *Sphagnum subsecundum* (C/F₁₉, section *Subsecunda*), with branch leaves that appear obtuse but are actually deeply concave and enrolled in the upper half, has a similar color as *S. papillosum* and grows in similar mesohabitat (but usually somewhat more aquatic and minerotrophic). It can be differentiated from *S. papillosum* by curved and whorled branches with curved-secund leaves in its capitulum.

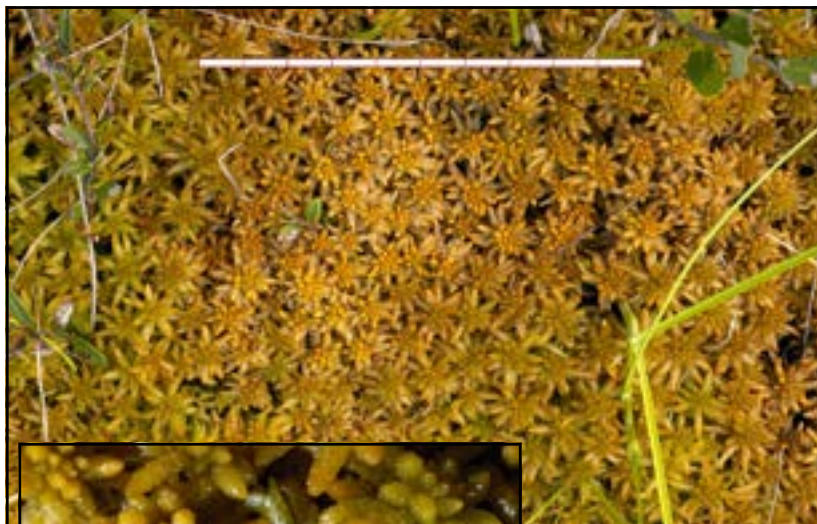
Associated Species: Mesohab: *Sphagnum magellanicum*, *Polytrichum strictum*, *Sphagnum angustifolium*, *S. rubellum*, *Aulacomnium palustre*, *Sphagnum fallax*, *S. fuscum*, *S. subsecundum*, *S. majus*, *Cladopodiella fluitans*; Pop: *Sphagnum rubellum*, *S. angustifolium*, *Polytrichum strictum*, *Sphagnum magellanicum*.



carpets often encroaching over hollows in open poor fen



SPHAGNUM PAPILLOSUM



above: golden-brown, densely packed, but soft carpets



left: plants with short, stubby branches in capitulum (blue arrow)

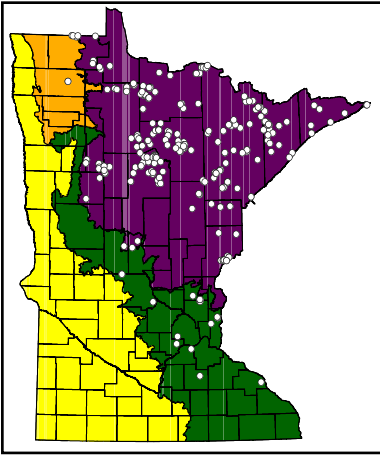


below left: stem dark-brown

below: branch leaf with small teeth (squamae) at the back of the cucullate apex (red arrow), only visible with the 20x handlens in the field



SPHAGNUM RUBELLUM (SECTION ACUTIFOLIA)



Synonym: *Sphagnum capillifolium* var. *tenellum*.

Abundance: Common (C₁).

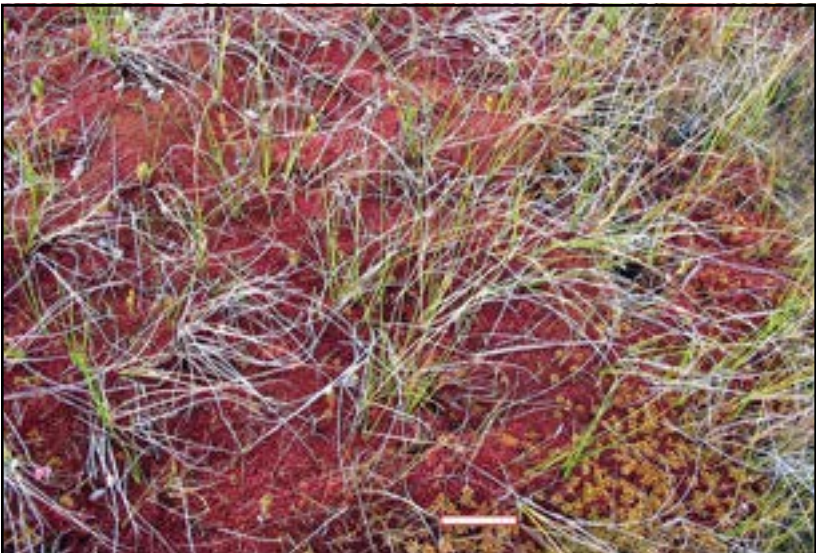
Habitat and Field Aspect: Common in northern poor fen. Frequent in northern open bog. Occasional in northern poor conifer swamp and spruce bog. Recorded from northern transitional fen, cedar/fir swamp and rich fen and spruce swamp. It forms **extensive lawns near the water table, or surrounds the lower slope of large hummocks**. The plants are **closely packed and form smooth carpets**, but they feel soft, not firm and stiff as is the case with species that form taller hummocks. In exposed mesohabitat the entire carpet has a distinctive, **bright-red color**. In shaded situations the individual plants can be **mottled green-red** or even green throughout, except for the stem and antheridial branches.

Aid to Identification: The **capitula are small and flat-topped or slightly domed**, with a **single pendent branch** between the radii. The **branch leaves are often somewhat 5-ranked** and **second** in dry plants. The **stem leaf**, best studied after removing the capitulum and looking at the remaining crown of leaves with the 20x handlens,

is lingulate to lingulate-triangular.

Look-Alike Species: *Sphagnum rubellum* is smaller than the similarly red *S. magellanicum* (C₁) of the section *Sphagnum*. Of the 'small red sphagna' of the section *Acutifolia* three other species are common or frequent: *S. warnstorffii* (C₁₅) has distinctively 5-ranked branch leaves, is often tinted bluish, and occurs only in highly minerotrophic peatland; *S. capillifolium* (F₁₄) is most closely related to *S. rubellum* in structure, but forms higher hummocks and has a rounded hemi-spherical capitulum; *S. russowii* (F₁₁), often a mottled green-red, grows in similar open mesohabitats as *S. rubellum* but is more restricted to poor fen – its terminal bud is often enlarged, not seen in *S. rubellum*. Other 'small red sphagna' are *S. quinquefarium* (U₂) with strongly 5-ranked branch leaves, a triangular stem leaf, and three spreading branches in most fascicles; *S. subtile* (F₁₂), with two pendent branches per fascicle, unranked branch leaves and a stem leaf that is shorter than that of *S. rubellum*; and *S. subfulvum* (O₆) often brownish and with a metallic sheen when dry.

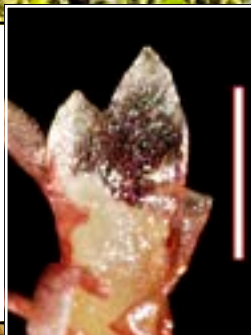
Associated Species: Mesohab: *Sphagnum magellanicum*, *Sphagnum angustifolium*, *Polytrichum strictum*, *Aulacomnium palustre*, *Sphagnum fuscum*; Pop: *Polytrichum strictum*, *Sphagnum magellanicum*.



small plants in smooth soft carpets near the water table, bright red in exposed habitat



SPHAGNUM RUBELLUM



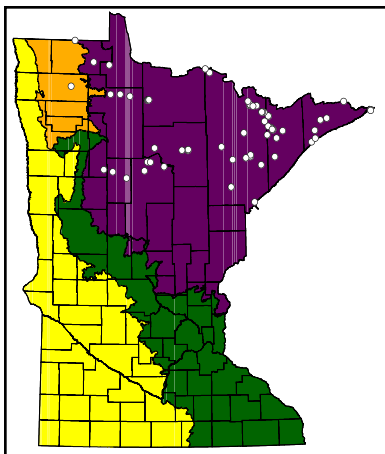
above: mottled green-red population in shaded habitat

middle: 5-ranked branch leaves and flat-topped capitula with a single spreading branch (arrow) and long-oblong stem leaf with triangular pointed, sometimes slightly more rounded apex

below: smaller red capitula with sporophytes; the larger whitish capitulum is that of *S. angustifolium*, which, typically for the section *Cuspidata* species, dries out earlier and turns white



SPHAGNUM RUSSOWII (SECTION ACUTIFOLIA)



Abundance: Frequent (F₁₁).

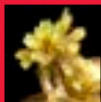
Habitat and Field Aspect: Frequent in forested acid- and forested rich-peatland, with high fidelity in basin and patterned rich black-spruce swamp. Occasional in patterned rich tamarack swamp, in slightly minerotrophic poor conifer swamp, and in spruce bog with seasonal groundwater influence and a significant component of tamarack. Recorded from wet depressions in upland mesohabitat or in contact with felsic mineral soil or rock. The **stiff, robust plants** form small carpets or low hummocks with a slightly rough surface. The **variegated color scheme of green and red** is only well developed in exposed microhabitat.

Aid to Identification: The **capitula are flat-topped or slightly domed, with stubby branches**, and a **small terminal bud** might be discerned. The **stem leaves are lingulate with a rounded apex, often notched**. **Young pendent branches are not paired** and **branch leaves not five-ranked**.

Look-Alike Species: This species is not easily differentiated from more robust modifications of other 'small red sphagna'. It is most similar to *S. warnstorffii* (C₁₅), but never found in the highly minerotrophic peatlands to which the latter is restricted. *Sphagnum warnstorffii* has often a distinct purplish tint, and its branch leaves are markedly five-ranked. *Sphagnum rubellum* (C₁₄), commonly occurring in mesohabitat with low minerotrophy in which *S. russowii* is also found, has no enlarged terminal bud. In addition, *S. russowii* is similar to *S. capillifolium* (F₁₄) and both occur in the same mesohabitat. Only the enlarged terminal bud and the rounded (but often enrolled and then appearing lingulate-triangular) stem-leaf with notched apex will differentiate *S. russowii* diagnostically from *S. capillifolium*. Microscopic confirmation is needed if field conditions don't allow for clearly observing the stem leaves or the shape of the capitulum isn't convincing one way or the other. When dry there is no metallic sheen to the plants of *S.*



sturdy plants forming smooth to slightly rough carpets on low hummocks



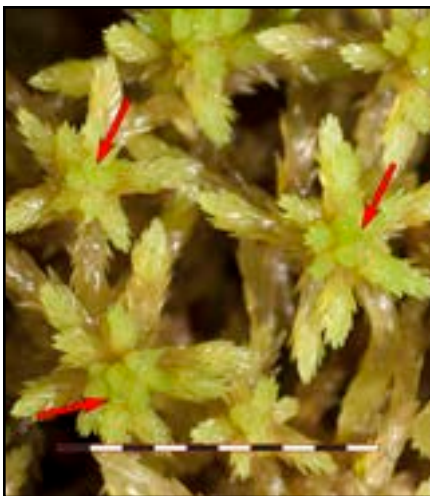
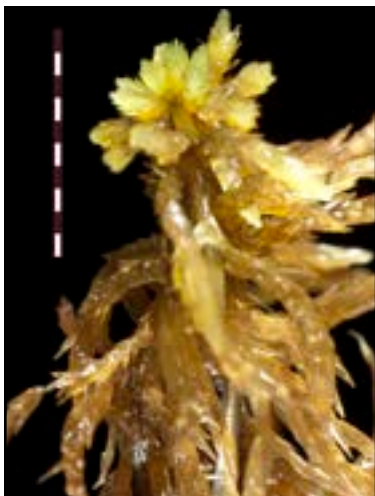
SPHAGNUM RUSSOWII

russowii, as seen in *S. subfulvum* (O₆). Robust plants of *Sphagnum russowii* are also similar to those of the *S. quinquefarium* (U₆), but no good material of the latter has been collected yet in Minnesota. It is characterized by three rather than two spreading branches per fascicle.

Associated Species: Mesohab: *Pleurozium schreberi*, *Sphagnum magellanicum*, *Sphagnum angustifolium*, *Aulacomnium palustre*, *Ptilidium pulcherrimum*, *Callicladium haldanianum*, *Sphagnum rubellum*; Pop: *Sphagnum angustifolium*, *Sphagnum magellanicum*, *Pleurozium schreberi*.

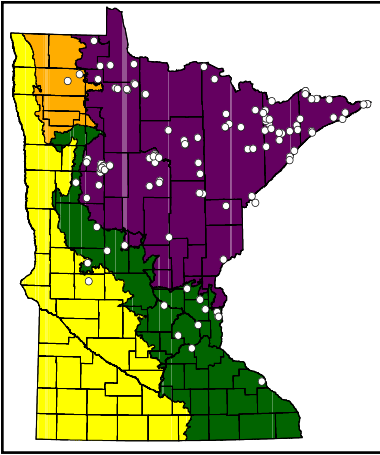


densely packed plants with often variegated green-red colored branches



robust plants with near flat-topped capitula; terminal buds slightly enlarged (red arrows)

SPHAGNUM SQUARROSUM (SECTION SQUARROSA)



Abundance: Common/Frequent (C/F₁₈).

Habitat and Field Aspect: Occurring in most minerotrophic wetland types. Common in marsh among coarse graminoids, but also frequent in forested rich peatland (with cedar, tamarack, most characteristically with alder), and in wet forest, associated with alder or black-ash. Found in transitional fen, and open or forested poor fen. *Sphagnum squarrosus* is a large plant forming expansive low hummocks or extensive carpets, in shrubby mesohabitat often draping over coarse woody debris. It is always **light-green to green, seldom yellowish-green**. Its **spiky appearance** is its easiest recognizable field characteristic.

Aid to Identification: The **branch leaves** on the large spreading branches and also on the smaller branches of the capitulum have an **abruptly squarrose-recurved and sharply-pointed apex**. Most populations consists of **large, green plants, with the capitula well over 2 cm in diameter**. The terminal bud is clearly enlarged.

Look-Alike Species: When well developed it is one of our easiest species to recognize. Sometimes, however, the plants are smaller and more compact: the bristly

appearance is still obvious, but the smaller *S. teres* (C/F₁₉), also belonging to the section *Squarrosa*, might be considered as a possible identification. The latter is usually more strongly pigmented, even brown when growing exposed. Rarely encountered intermediate forms can be differentiated only by less reliable microscopic characters. *Sphagnum centrale* (C₁₇), which grows in similar mesohabitat, has also a light-green color and is often as robust as *S. squarrosus*. However, its branch leaves are cucullate. Juvenile stems of many *Sphagnum* species happen to have squarrose-recurved leaves, but these stems are clearly atypical among the more mature ones.

Associated Species: Mesohab: *Callicladium hal-danianum*, *Aulacomnium palustre*, *Pleurozium schreberi*, *Calliergon cordifolium*, *Plagiomnium ellipticum*, *Hypnum lindbergii*, *Brachythecium sale-brosum*, *Sphagnum magellanicum*; Pop: *Calliergon cordifolium*, *Straminergon stramineum*.



light-green, green, to yellow-green large-sized plants with a bristly appearance, caused by the strongly squarrose-recurved leaves of the spreading branches

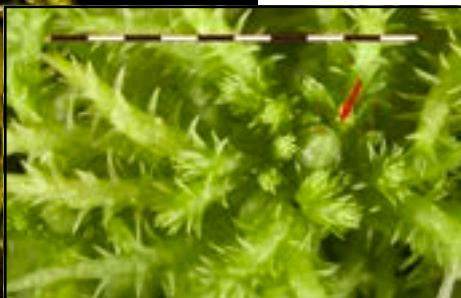


SPHAGNUM SQUARROSUM

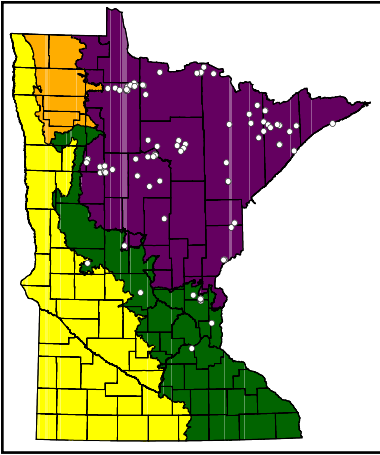


branch leaves with squarrose-recurved apex (above and left) and large capitulum, typically > 2 cm in diameter, with a clearly visible enlarged terminal bud (below)

Note: the brown-pigmented leaves shown on the plant on the left and above are not colored by plant-produced pigments, but are stained by humics lodged in the hyaline cells and at the enrolled leaf tips: after water has been wicked up by the plants and has evaporated during dry periods, brown organics are left behind; often *Sphagnum* plants can turn quite black this way, and appear burned



SPHAGNUM SUBSECUNDUM (SECTION SUBSECUNDA)



Abundance: Common/Frequent (C/F₁₅).

Habitat and Field Aspect: Excellent indicator for circumneutral minerotrophic peatland and wetland such as transitional and shrub-shore fen and northern mixed cattail marsh. Occasional in either more acid northern poor fen, or more alkaline open northern rich fen and rich tamarack swamp. Recorded from northern wet meadow, inland lake shore, and alder swamp. Later in the growing season, if not shaded, it develops a **rich golden-brown color**. The carpets or **small hummocks are soft, nearly level with the water table**, and the **small and wiry plants are only loosely packed**, sometimes floating separately.

Aid to Identification: Most characteristic is the appearance of the capitulum: the **branches are curved in a horizontal plane and their individual leaves are also curved-secund**; **there is no obviously enlarged terminal bud**. The golden-brown to orange pigmentation is not always developed, but the stems are often reddish-brown, and the **plants are shiny when dry**. It is a **small**

Sphagnum species (capitulum diameter < 1 cm), and male plants are even tinier, with just a few tightly twisted branches in a bud-like capitulum. The **branch leaves are pointed but appear obtuse**, being short-ovate and strongly concave. The **stem leaves are distinctly smaller than the branch leaves**.

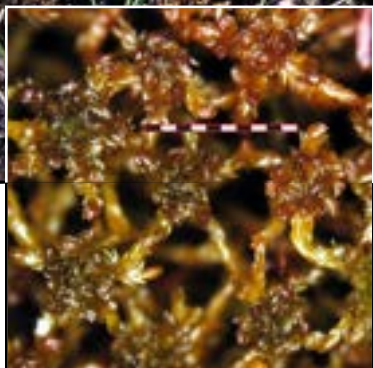
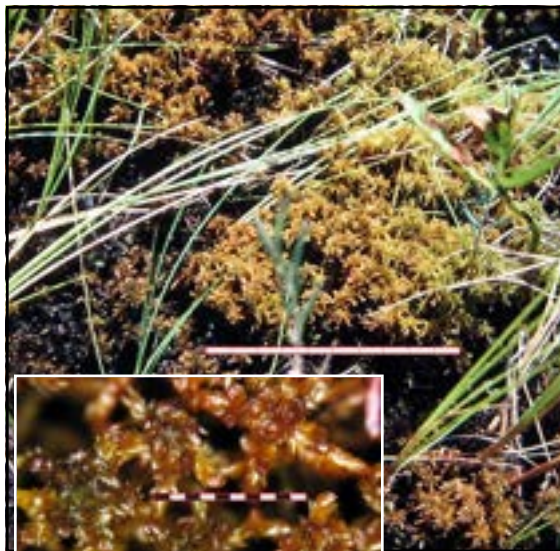
Look-Alike Species: More aquatic modifications of *S. subsecundum* are hard to differentiate from other Minnesota species in the section *Subsecunda*. Both *S. platyphyllum* (F/O₃) and *S. lescurii* (R₁) have stem leaves



aspect of a partly emergent *S. subsecundum* carpet, capitula with curved branches



SPHAGNUM SUBSECUNDUM



above: well developed
orange golden-brown
pigmentation

left: small male plants

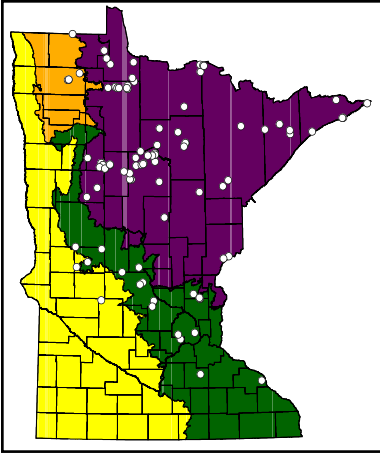
that are as large or larger than the branch leaves, and the first has a large terminal bud. *Sphagnum contortum* (F_{11}) is the species most similar to *S. subsecundum*, but is more restricted to highly minerotrophic semi-aquatic and open habitat. It can only be differentiated from *S. subsecundum* by microscopic characters. Except for *S. contortum*, none of the other small *Sphagnum* species in Minnesota have the combination of micro-habitat, color, and field aspect as described above for *S. subsecundum*. The frequently brown-pigmented *Sphagnum teres* (C/F_{10}), *S. majus* (F_{10}), and *S. fuscum* (C_{14}) are either larger with straight branches and branch leaves, or form high, dense hummocks in more acidic peatland.

Associated Species: Mesohab: *Aulacomnium palustre*, *Sphagnum magellanicum*, *Sphagnum angustifolium*, *Polytrichum strictum*, *Callicladium haldanianum*, *Sphagnum centrale*; Pop: *Aulacomnium palustre*, *Straminergon stramineum*.



left: shiny dry plant with distinct twisted appearance of branches and leaves
right: wet plant with orange-brown mature stem

SPHAGNUM TERES (SECTION *SQUARROSA*)



Abundance: Common/Frequent (C/F₁₉).

Habitat and Field Aspect: Common in forested rich peatland, mostly associated with tamarack. Frequent in mixed conifer and alder swamp, but also found in rich open fen and in shore fen. Occasional in wet ash swamp, poor fen, and alder carr. Forming low hummocks or pure carpets, often **reddish to golden-brown in more exposed habitat**.

Aid to Identification: Medium-sized plants with **long slender spreading branches**. A **conspicuous terminal bud** is centered among the branches of the capitulum. The **stem leaves**, to be observed in the field after removing the capitulum and stripping the branches, are **long-lingulate with narrowly truncated apex**. The **leaves on older branches lower along the stem are often squarrose-recurved**.

Look-Alike Species: Most similar to *S. girgensohnii* (F₁₃) and sometimes growing in the same mesohabitat. However, *S. girgensohnii* is always green, at the most yellowish green, has a far more distinctly stiff and stellate appearance, and its branch leaves are straight. Green

shade modifications of these two species are best differentiated by studying the stem leaf: long-lingulate and often with an abruptly truncated apex in *S. teres*, but shorter and wider, with a distinctly fibrillose and gradually rounded apex in *S. girgensohnii*. *Sphagnum teres* is generally brown, with dark stems, and, along the older branches, its branch leaves are frequently squarrose-recurved, establishing its relation with



golden-brown, medium-sized plants with long slender branches and enlarged terminal buds



SPHAGNUM TERES

S. squarrosus (C/F₁₈). However, *Sphagnum teres* is usually a lot smaller than *S. squarrosus* (capitulum < 2 cm in diameter), but intermediate shade modifications do occur rarely and can only be tentatively identified using microscopic characters. Larger plants of *S. angustifolium* (C₁₉) are also similar in field aspect, but these distinctly show one to several stacked pairs of young pendent branches between the rays of the stellate capitulum, and, when pressed between the fingers to squeeze out water, turn whitish and have undulate and wavy branch-leaf margins. Other species with sharply pointed branch leaves are usually smaller, have either red pigment, and/or have a far less obvious terminal bud. Another robust *Sphagnum* is *S. wulfianum* (C/F₁₄), but this species is never brown and has a near-spherical capitulum supported by a stiff, woody stem.

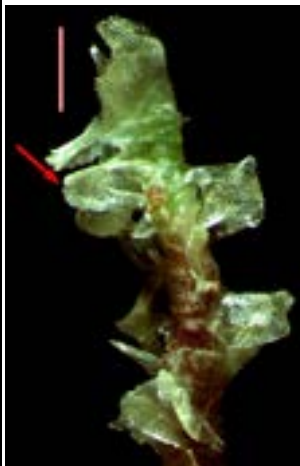
Associated Species: Mesohab: *Aulacomnium palustre*, *Callicladium haldanianum*, *Sphagnum centrale*, *Sphagnum angustifolium*, *Pleurozium schreberi*, *Plagiomnium ellipticum*, *Sphagnum magellanicum*, *Hypnum lindbergii*, *Sphagnum warnstorffii*, *Lophocolea heterophylla*, *Climacium dendroides*; Pop: *Sphagnum angustifolium*, *Aulacomnium palustre*.



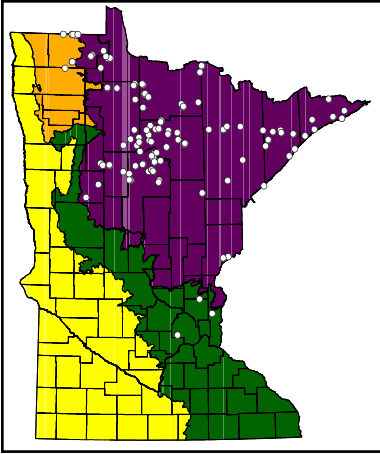
top: stem leaves enrolled together in a prominent large and sharply pointed terminal bud

left: leaves often squarrose-recurved along the more mature spreading branches lower down on the stem

below: stem leaf long-oblong with truncate apex



SPHAGNUM WARNSTORFII (SECTION ACUTIFOLIA)



Abundance: Common (C_{15}).

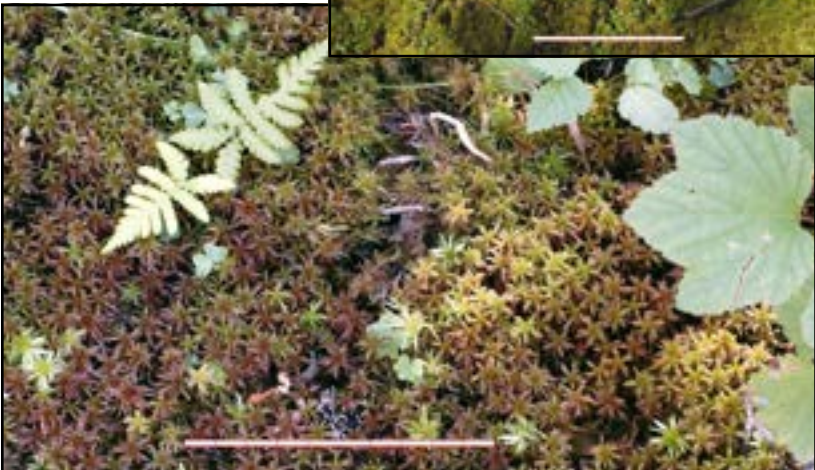
Habitat and Field Aspect: Common in forested rich peatland and frequent in wet forest: in tamarack and black spruce swamp, and alder swamp and carr. Occasional in rich conifer, cedar, and wet ash swamp. Encountered in open rich peatland, often in rich-fen water track and shrub shore fen. In acid peatland only found in open transitional fen and rarely in poor conifer swamp. The species forms **small tufts to moderately larger, loose carpets**, emergent but close to the local water table. In densely forested habitat it can form **low hummocks**, or rarely taller ones, draped along the base of trees.

Aid to Identification: This small to medium-size species frequently occurs as a green to olive-green modification in densely forested habitat, and as such is not easily recognized by field aspect alone. When pigments are present, however, it often has a **bluish tint to its usually reddish-green variegated color**. The **capitula are fairly flat-topped and stellate**. Most characteristically, it **grows in highly minerotrophic situations** (for a *Sphagnum*) and its **branch leaves are nearly always distinctly**

5-ranked. Stem leaves are quite short and lingulate triangular when seen in profile at the tip of a broken stem after removal of the capitulum.

Look-Alike Species: Most similar to *S. capillifolium* (F_{14}), *S. russowii* (F_{13}), and *S. rubellum* (C_{14}). It is different from the first two by its distinctly 5-ranked branch leaves, and from the latter by much shorter stem leaves, bluish hue when present, and its highly minerotrophic habitat preference. There is rarely a trace of an enlarged terminal bud among the small branches of the capitulum, as is frequent in *S. russowii*. Other 'small red sphagna' have either a metallic sheen when dry (*S. subfulvum*, O_6), or 3 spreading branches per fascicle (*S. quinquefarium*, U_3).

Associated Species: Mesohab: *Aulacomnium palustre*, *Pleurozium schreberi*, *Plagiomnium ellipticum*, *Callicladium haldanianum*, *Hypnum lindbergii*, *Climacium dendroides*, *Thuidium recognitum*; Pop: *Aulacomnium palustre*, *Helodium blandowii*.



small stellate plants, growing in highly minerotrophic habitat, as smooth loose carpets or low hummocks, often with bluish tint



SPHAGNUM WARNSTORFII



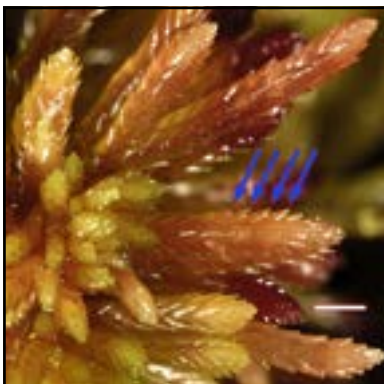
variegated purplish capitula, mostly flat-topped and stellate



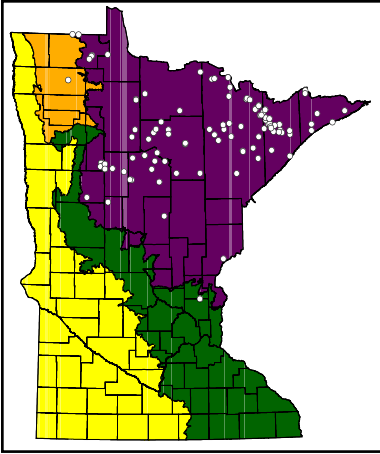
left: branches long and tapering, fascicles distant and stem visible

above: branch leaves 5-ranked

right: short-triangular stem leaf



SPHAGNUM WULFIANUM (SECTION *POLYCLADA*)



Abundance: Common/Frequent (C/F₁₄).

Habitat and Field Aspect: Frequent in all forested rich peatland types: tamarack, spruce, cedar/fir, and mixed conifer swamp. Occasional in rich northern wet conifer forest, northern alder swamp, poor conifer swamp, poor fen, and spruce bog. Recorded from bedrock depressions in conifer woodland. Plants might be mottled green-brown, but are usually dark green to yellow- or greyish green. There is no obvious red pigment. Recognizable from a distance by the **rough-surfaced carpets draping over highly decomposed coarse woody debris**.

The individual plants can grow separately from each other because of the sturdy stems, and the large spherical capitula attain thus varied heights in profile.

Aid to Identification: The **sturdy, woody stem breaks with an audible snap**. Its **wood cylinder is dark-reddish brown**. The plants are woolly looking because of the **large number of spreading and pendent branches (6 to 12) in each of the fascicles**, covering and completely hiding the stem. The **spherical capitula** are large, without any extending spreading branches. When dry, **the very small, sharply-pointed branch leaves have strongly recurved apices**.

Look-Alike Species: Few other sphagna attain similar individual plant size as *S. wulfianum*, and none have such a rough-carpet look. *Sphagnum squarrosum* (C/F₁₈) and *S. centrale* (C₁₇), two other large and green species, occur frequently in similar mesohabitat, but have stellate capitula. In addition, the branch leaves of *S. centrale* are larger and characterized by cucullate apices. *Sphagnum squarrosum* has squarrose-recurved branch leaves, and these leaves are also much larger — and the plants themselves are far from as sturdy — as those of *S. wulfianum*. Species with small branch leaves, such as *S. angustifolium* (C₁₉), *S. girgensohnii* (F₁₃), and *S. teres* (C/F₁₉), when occurring on somewhat drier coniferous forest floor, can also grow as large, stiff, and yellow-green plants, and then have more domed, less-stellate capitula than typical, and might approach the size of smaller *S. wulfianum* plants. However, they still will be differentiated by lacking the completely spherical capitula of *S. wulfianum*, and each of their branch fascicles has less than six branches.

Associated Species: Mesohab: *Pleurozium schreberi*, *Callicladium haldanianum*, *Sphagnum magellanicum*, *Dicranum flagellare*, *Ptilidium pulcherrimum*, *Aulacomnium palustre*, *Sphagnum angustifolium*, *Tetraphis pelucida*, *Plagiomnium ellipticum*, *Hylocomium splendens*; Pop: *Pleurozium schreberi*.



recognizable from a good distance by the rough-surfaced carpets on the forest floor



SPHAGNUM WULFIANUM



plants growing separately from each other, supported by sturdy, woody stems



above: plants with large, spherical capitula



left: stiff stem covered by a mat of pendent branches

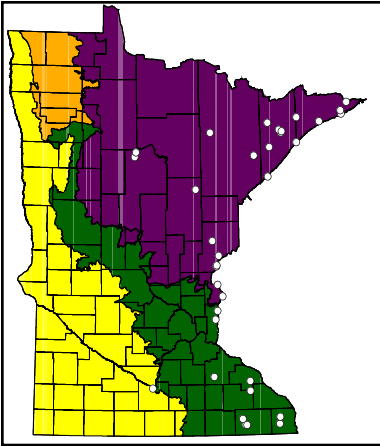


fascicle with 4 pendent (center) and 4 spreading branches (outside)



POLYTRICHALES

ATRICHUM CRISPULUM



Synonym: *Atrichum oerstedianum*.

Abundance: Frequent/Occasional (F/O₁₅).

Habitat and field aspect: Frequent in northern, central, and southern mesic hardwood forest. Occasional in northern wet forest (wet and very wet ash swamp). Recorded from southern dry-mesic woodland, southern mesic cliff and open talus, and bedrock/boulder river shore. Under dry microhabitat conditions the plants are easily recognized because of their **large size** (up to 6 cm tall), and **enlarged head** (up to 0.8 cm in diameter) formed by the **strongly crisped and enrolled upper leaves**. The **wet leaves, 5 to 9 mm long, appear strap-like, and show undulations on the upper lamina**. They are also widely spreading, similar to species of *Polytrichum* and related genera within the order Polytrichales.

Aid to Identification: With the 20x handlens it is possible to discern the **few (4-6) low adaxial lamellae** running longitudinally along the top of the narrow costa. Also the **sharp marginal teeth** are visible.

Look-Alike Species: Several other species of *Atrichum* are found in the state, and field identification is usually not possible without microscopic confirmation. *Atrichum altecristatum* (F/O₁₆) is the most frequently found, and has somewhat narrower leaves and taller lamellae. The lamellae of *A. angustatum* (O/U₁) are even taller and distinctly wavy, and in the upper part of the leaves might cover the lamina. *Atrichum crispum* (R₃) and *A. tenellum* (U₁) are state proposed special concern species. They are smaller, and have less well developed lamellae and marginal teeth. The leaves of *Atrichum* species also lack differentiated sheaths wrapping along the stem, in contrast with those of the other Polytrichales in Minnesota (*Polytrichum*, *Polytrichastrum*, and *Pogonatum* species), which also have much wider costae and more numerous lamellae. Similar in aspect to *A. crispulum* is also the unrelated *Timmia megapolitana* (Timmiales, F₃), but this species has no adaxial lamellae and the proximal part of the leaf is distinctly sheathing along the stem. *Rhodobryum ontariense* (Bryales, F₁₄) is also a large woodland and forest floor species, but its upper leaves are obovate, smooth, and again without adaxial lamellae. They are even more strongly clustered than those of *A. crispulum*, forming distinct comal heads.

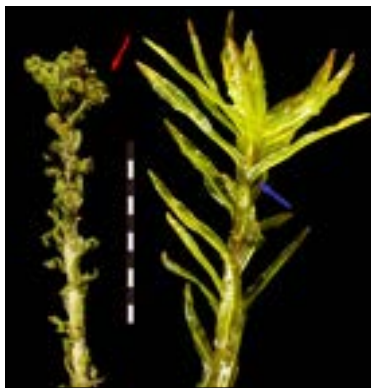


populations common on hardwood forest floor or along trails; when drying the plants are typically tightly shrivelled (arrows)



ATRICHUM CRISPULUM

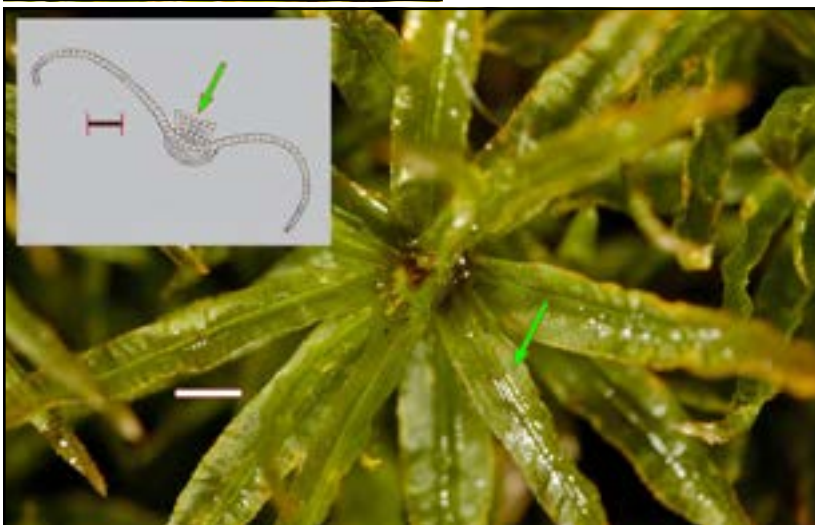
Associated Species: MesoHabit: *Plagiomnium cuspidatum*, *Platygyrium repens*, and *Brachythecium acuminatum*; Microhab: *Callicladium haldanianum*, *Plagiomnium cuspidatum*, and *Dicranum flagellare*; Pop: *Brachythecium erythrorrhizon* and *Plagiomnium cuspidatum*.



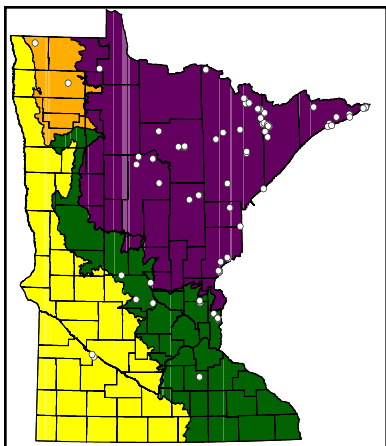
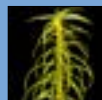
above: wet plant (right) with narrowly lingulate leaves, sharply toothed and undulate in the distal part; there is no sheath clasping the stem (blue arrow); dried plant to left, strongly crisped leaves (red arrow)

left: a somewhat drier plant above a still saturated one: note the initially incurving and then strongly crisped nature of the leaves

below: with the 20x handlens it is possible to see the few abaxial lamellae on the costae (green arrows), appearing as longitudinal and low single-cell thick cell walls



POLYTRICHUM COMMUNE



Abundance: Frequent (F₁₆).

Habitat and field aspect: Frequent in northern black spruce and tamarack poor fen. Found along Lake Superior or rocky shore, in northern and central mesic hardwood forest, and in northern dry pine woodland. Recorded from northern mesic black spruce and alder swamp, and from northern wet ash and wet meadow/carr. The species often occurs in ecotones, associated with somewhat disturbed habitat. **Large solitary hummocks** in partly shaded mesohabitat. Our largest upright growing moss, as **stems can reach a length of over ½ m**, mostly tightly packed together in a sturdy hummock.

Aid to Identification: **Tall upright and mostly unbranched** plants of **non-transparent green** color. The leaves consist of two distinct parts, a **clasp basal sheath** tightly surrounding the stem, and an erect to somewhat down-curving **lamellose green limb**. The lamellae are positioned on the adaxial surface of a costa nearly as wide as the leaf. Frequently producing **sporophytes with box-shaped capsules**.

Look-Alike Species: *Polytrichum commune* is less common than *P. strictum* (C₁₇). Typically it is differentiated

from this *Polytrichum* species, and from *P. juniperinum* (C/F₂₀), *Polytrichastrum alpinum* (F/O₃), and *Polytrichastrum longisetum* (F₁₇), by its larger size and the sharply toothed and narrow leaf limbs that curve gracefully downward when the plants are wet. The laminal margins of the leaves of both *P. juniperinum* and *P. strictum* are folded over the costal lamellae, easily visible with the handlens as a jointed and glossy cover. The costal lamellae of *P. commune*, as well as those of *P. alpinum* and *P. longisetum*, are exposed and give the plants a more matte aspect. *Polytrichastrum alpinum* often occurs on moist cliffs and doesn't have the typical down-curved leaves of *P. commune*. *Polytrichastrum longisetum* can be as large as *P. commune* and also forms tall hummocks, but the toothed margins adjacent to its costa form a wider lamina. They show clearly on wet plants, but are often enrolled on dry plants. There are several other smaller hair-cap mosses (*Polytrichum* and *Polytrichastrum* species, F to U), but they can only be clearly differentiated by using microscopic characters. Similar large plants with leaves strongly differentiated in sheath and limb, but without costal lamellae, belong to the genus *Timmia* (F to U).

Associated Species: Mesohab: *Aulacomnium palustre*, *Pleurozium schreberi*, *Callicladium haldanianum*, *Sphagnum angustifolium*; Microhab: *Callicladium haldanianum*, *Plagiomnium cuspidatum*, *Hypnum pallescens*, *Brachythecium acuminatum*; Pop: *Sphagnum angustifolium*, *Pleurozium schreberi*, *Sphagnum magellanicum*.



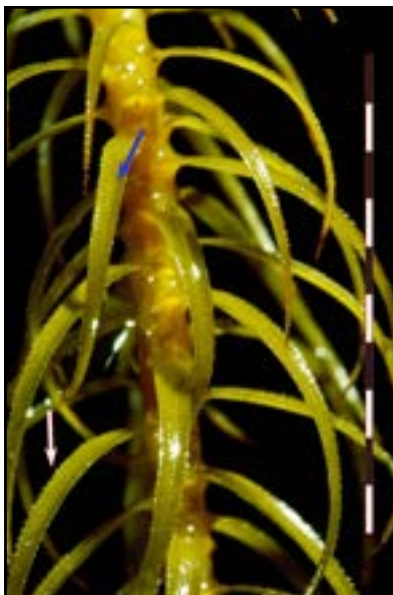
large solitary hummocks at edge on wet-mesic forest floor



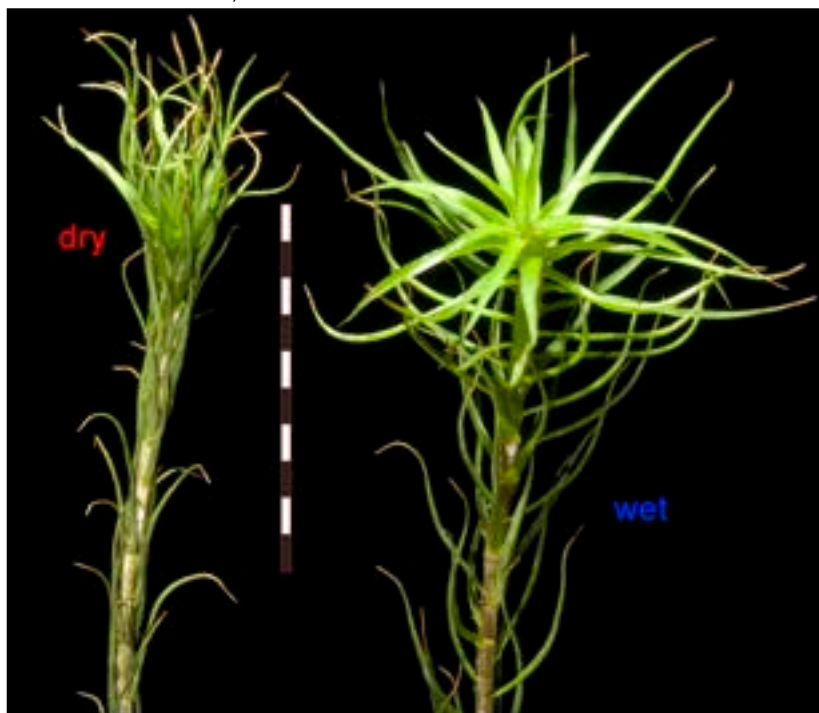
POLYTRICHUM COMMUNE



below: large upright plants with long setae and box-like capsules

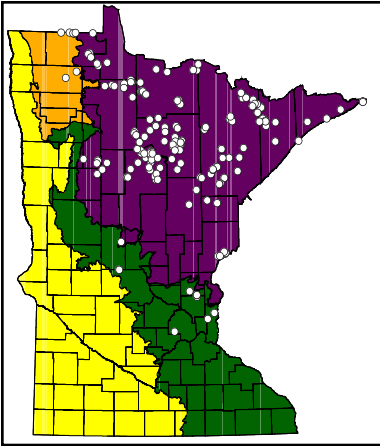
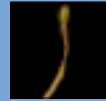


right: wet leaves have long limbs curved downward, with their edges sharply serrate (white arrow) and lamellae exposed (blue arrow)



wet versus dry plant: on the latter the tightly clasping and glossy leaf sheaths are more obvious

POLYTRICHUM STRICTUM



Abundance: Common (C₁₇).

Habitat and field aspect: Abundant in northern open bog, common in northern spruce bog, and poor and transitional fen, frequent in poor conifer swamp. Occasional in northern and northwestern forested rich peatland, usually in patterned black spruce and tamarack swamp, but also associated with alder and cedar/fir. Found in northern rich fen, shrub shore fen, and in extreme rich fen. In addition to peatlands also recorded from northern wet forest, fire-dependent forest, wet meadow/carr, Lake Superior rocky shore, and rich mesic hardwood forest. *Polytrichum strictum* usually forms either pure hummocks or grows as small clones or as scattered plants at the top of high *Sphagnum* hummocks. The plants are well adapted to their micro-xerophytic niche: their **leaves are strongly appressed against the stem when dry**, the **lamellae are covered by the inrolled laminae**, and the **rhizoids form an effectively wicking tomentum** around the older stem portions.

Aid to Identification: The leaves are differentiated in a **proximal hyaline sheath** that wraps around the stem and a **distal limb with a very wide costa**. The **inrolled laminae** are visible with the 20x handlens, forming a transparent and glossy cover over the **numerous costal lamellae**. The **white (when squeezed dry) to yellow-brown (when wet) tomentum** is highly characteristics on taller plants.

Look-Alike Species: *Polytrichum juniperinum* (C/F₁₀) is very similar, but grows on terrestrial and mineral substrates. It doesn't form such obvious whitish tomentum as *P. strictum* and the plants are usually shorter and more compact. *Polytrichum piliferum* (F/O₁₈) also shares the same leaf structure, but the costa is excurrent as a long hyaline awn, rather than the short reddish point of leaves of *P. strictum* and *P. juniperinum*. The other hair-cap mosses of Minnesota (*Polytrichum* and *Polytrichastrum* species) have erect and narrow laminae when the leaves are wet, and their costal lamellae are exposed. *Timmia megapolitana* (F₆) has a leaf similarly differentiated in sheath and limb, but there are no costal lamellae.

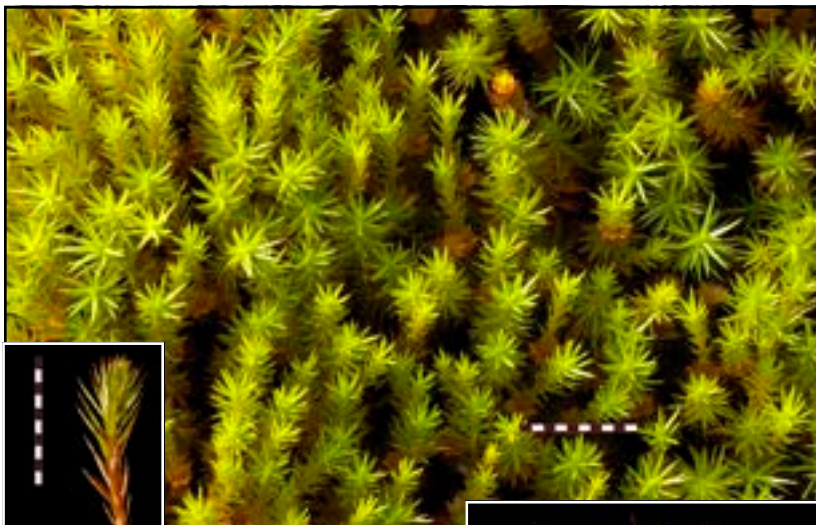
Associated Species: Mesohab: *Sphagnum magellanicum*, *S. angustifolium*, *Aulacomnium palustre*, *Sphagnum fuscum*, *Pleurozium schreberi*; Pop: *S. magellanicum*, *Aulacomnium palustre*, *Sphagnum capillifolium*.



a large clone forming a tall hummock in a poor-fen leatherleaf lawn



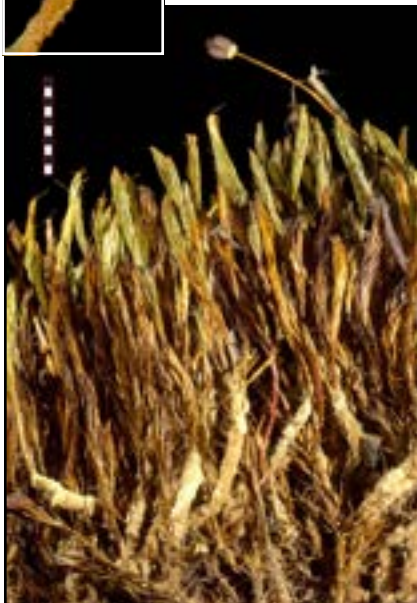
POLYTRICHUM STRICTUM



above and below right: small plants (for a *Polytrichum*) in a dense turf

left and below left: the tomentum is brownish when wet but distinctly white when dry; leaves strongly appressed when dry

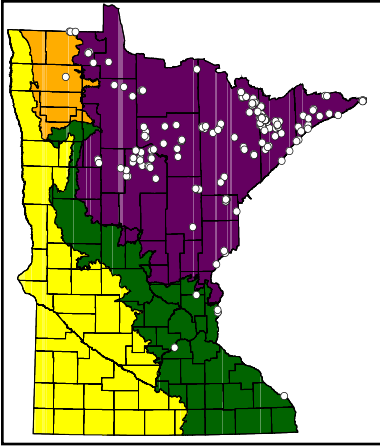
right: lamellae fold over the limbs of the leaves and are visible as a glossy jointed layer covering the costal lamellae (green arrows); the excurrent costa forms a short, either somewhat hyaline or reddish-brown, tip





DICRANUM

DICRANUM FLAGELLARE



Abundance: Common (C_{18}).

Habitat and field aspect: Common in the northern dry to mesic fire-dependent forest and woodland. Frequent in northern forested rich peatland, usually associated with black spruce, tamarack, and alder. Occasional in northern wet forest, either conifer or ash, and in spruce bog and poor conifer fen. Recorded from northwestern and southern rich conifer swamp, from Lake Superior wet rocky shore, mesic hardwood and mixed upland forest, and open graminoid rich fen. Common on rotten wood, usually logs and stumps, or firmly attached to bark at the base of trees and on branches. Also found frequently on organic detritus and on both rocky and sandy felsic substrate.

Aid to Identification: The characteristic **flagellate branches** are nearly always present. Once you have the proper search image, they are easy to spot (look at the clone in profile). The **regular leaves** are usually at least

somewhat curved-secund and **not fragile**, but those on the flagellate branches are very tiny and imbricate. Frequently sporophytes are present, and the **erect capsules** are diagnostic.

Look-Alike Species: Familiarity with size comes in handy with *Dicranum*: *D. flagellare* is a small species, but not as tiny as *D. montanum* (C_{18}). It is similar in size as *D. viride* (F_{14}) and somewhat smaller than medium-sized species such as *D. fuscescens* (F_7). It is quite a bit smaller than *D. ontariense* (C_{12}), *D. polysetum* (C_{11}), *D. scoparium* (C/F_{15}), and *D. undulatum* (F/C_{15}). Some other similar-sized acrocarpous species, other than *Dicranum*, have curved- to falcate-secund leaves, but these are either strongly crisped when dry (*Bartramia pomiformis*,



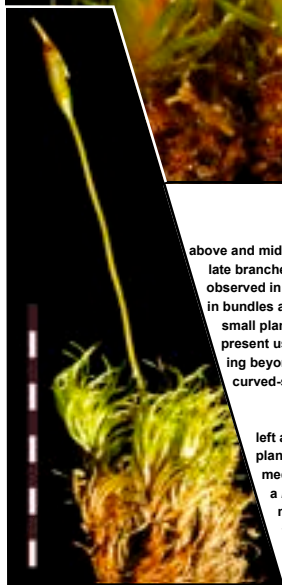
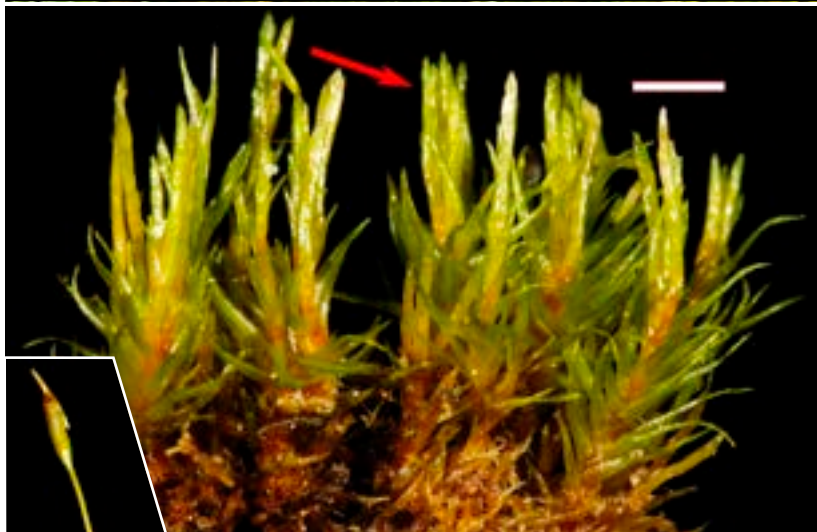
large clone covering an entire log on the mesic-hardwood forest floor

F/O_7), or clearly differentiated in a sheathing base and narrow, subulate upper limb (*Oncophorus wahlenbergii*, F_{12}). No other acrocarpous species has similar flagellate branches, but some pleurocarps do, such as *Anomodon attenuatus* (C/F_{17}), *Leskeella nervosa* (F_{10}), and *Leucodon andrewsianus* (O/U_1), but they are of entirely different aspect.

Associated Species: Meso-hab: *Callicladium haldanianum*, *Pleurozium schreberi*, *Ptilidium pulcherrimum*, *Tetraphis pellucida*; Microhab: *Callicladium haldanianum*, *Plagiomnium cuspidatum*, *Hypnum pallescens*, *Platygyrium repens*; Pop: *Callicladium haldanianum*, *Ptilidium pulcherrimum*, *Hypnum pallescens*.



DICRANUM FLAGELLARE

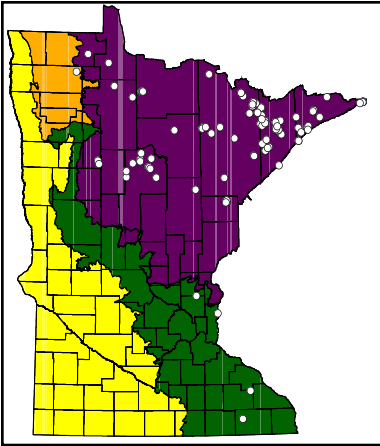


above and middle: the flagellate branches are easily observed in profile, often in bundles at the tip of the small plants and when present usually extending beyond the regular curved-second leaves

left and right: the plants are small to medium-sized for a *Dicranum* (± 5 mm wide) and the capsule is straight



DICRANUM MONTANUM



Abundance: Common (C_{14}).

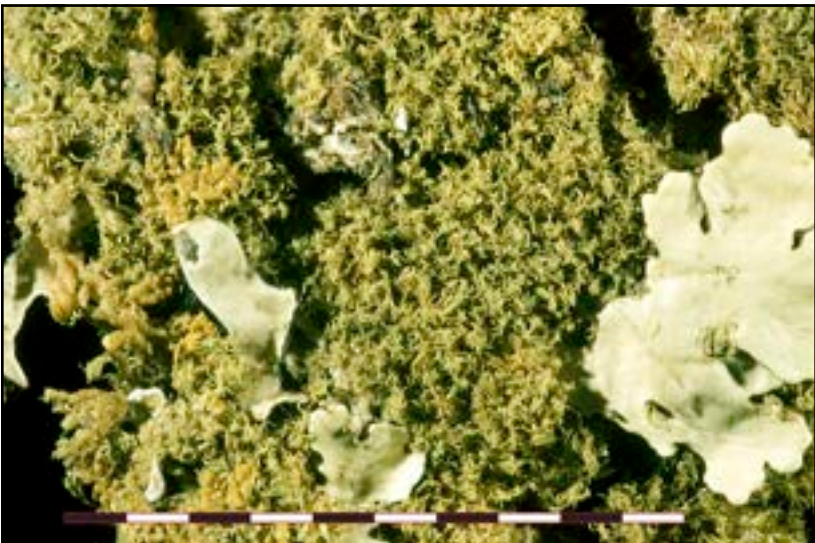
Habitat and field aspect: Common in northern dry to mesic fire-dependent forest and woodland, usually associated with conifers. Occasional in northern and southern forested rich peatland, mostly associated with black spruce and tamarack, less so with cedar, fir, and alder. Found in central and northern hardwood forest with conifer, and on krummholz Lake Superior rocky shore. Recorded from wet conifer forest and from northern spruce bog and poor black spruce swamp. Most commonly found as small compact clones on bark of conifer trunks and stumps, less frequent on fallen coarse woody debris, with or without bark. Also on rock, sand, and organic litter and humus. In distinctly xerophytic microhabitat.

Aid to Identification: Very small plants in **compact small turfs**, the **leaves highly crisped when dry**. When **wet the leaves are curved-to falcate secund** and with a 20x handlens it is possible to see a **slight roughness** (the

distal cells are mamilllose). Very **small brood plants nearly always present**, and sometimes the entire clone consisting of such propagula.

Look-Alike Species: Our smallest *Dicranum* (see discussion under *D. flagellare*, C_{18}). As the brood plants have the same structure as the regular plants and often occur in pure patches, it sometimes appears that there are two distinct sizes of *D. montanum*. When dry some small potticeous acrocarps might have the same aspect in the field as *D. montanum*, but when wetted will not have the characteristically secund leaves of a *Dicranum*, and will be usually less glossy (cells more papillose) and the leaves less subulate (more lanceolate or even lingulate). *Ceratodon purpureus* (C/F_{22}) leaves are also lanceolate rather than subulate, with distinct revolute margins.

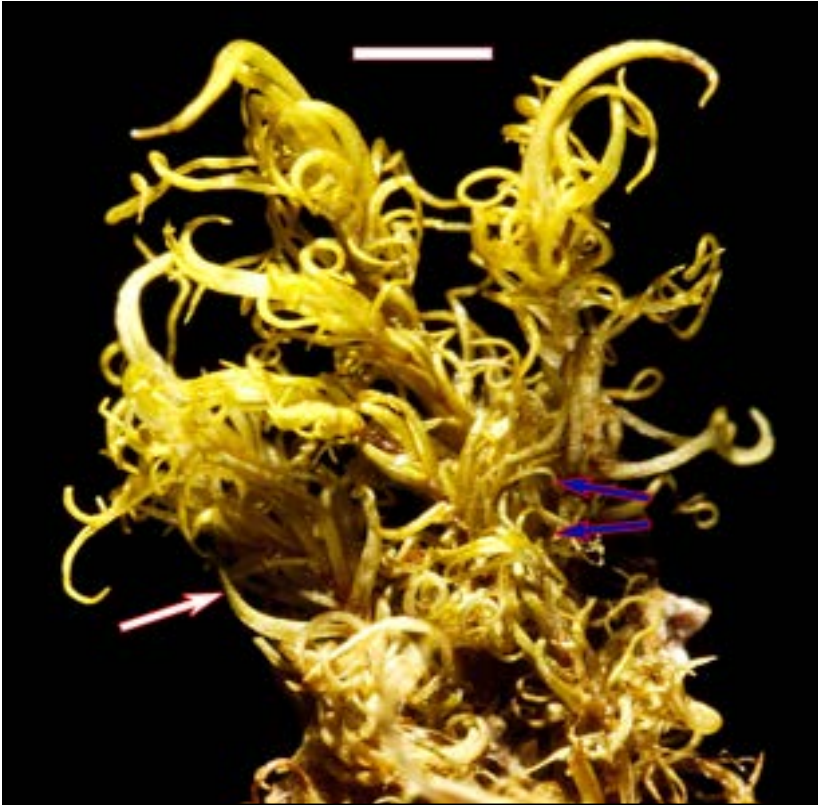
Associated Species: Mesohab: *Dicranum flagellare*, *Callicladium haldanianum*, *Ptilidium pulcherrimum*, *Pleurozium schreberi*, *Tetraphis pellucida*; Microhab: *Callicladium haldanianum*, *Plagiomnium cuspidatum*, *Hypnum pallescens*, *Platygyrium repens*; Pop: *Hypnum pallescens*, *Ptilidium pulcherrimum*.



turf of *Dicranum montanum*

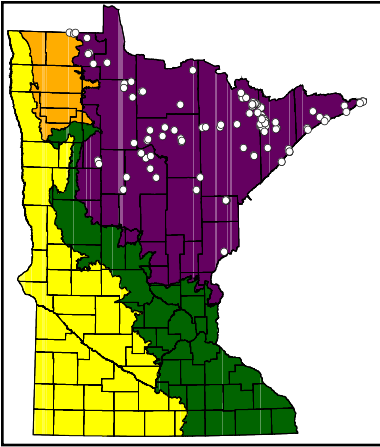


DICRANUM MONTANUM



larger plants and some attached smaller brood plants (blue arrows)
at higher magnification with a 20x handlens the somewhat rough cell surface aspect of the leaf apex is just visible
(white arrow)

DICRANUM ONTARIENSE



Abundance: Common (C_{12}).

Habitat and field aspect: Common in northern and central, dry to mesic, mixed woodland. Occasional in northern rich spruce, tamarack, and cedar/fir swamp, in wet forest, and in acid peatland in spruce bog and poor conifer swamp. Rare in open acid or rich peatland. Recorded from northern mesic felsic cliff. Large populations of *Dicranum ontariense* are nearly always found on forest-floor duff, such as conifer needle-litter, usually in a fairly xerophytic microhabitat. It does also occur on bark of trees at their base, on stumps, and on large fallen logs. It is rarely found on rotten wood, bare peat, or rock.

Aid to Identification: The **tall turfs** of *D. ontariense* are **matte yellow-green to light green** in color and the stems are covered by **dirty-white to yellow-brown tomentum**. The leaves are **distinctly crisped when dry**, and somewhat wavy rather than strongly undulate. When wet they are **curved-to falcate-secund** and show a **sharply acuminate apex**. The cells are rounded in the upper part of the leaves, as suggested when studied with the 20x handlens. The matte aspect is caused by

papillae on a large number of these isodiametric cells.

Look-Alike Species: With *D. polysetum* (C_{17}), *D. scoparium* (C/F_{18}), and *D. undulatum* (F/C_{15}) it belongs to the 4 large *Dicranum* species in Minnesota (see *D. flagellare* (C_{18}) for a discussion of relative size within *Dicranum*). It is differentiated by its crisped leaves and its matte aspect. It has been confused with *D. undulatum* for a long time: however, the leaf tips are more sharply acuminate than those of *D. undulatum*, which is more restricted to acid peatlands and which has stiff, more distinctly undulate, and nearly straight to slightly curved leaves, wet and dry. *Dicranum polysetum* is highly glossy, the leaves strongly undulate and often straight, its young stems covered by typically white tomentum. *Dicranum scoparium* is highly variable, but usually more glossy and less crisped when dry. When producing sporophytes, those of *D. ontariense* are often in groups of 2 to 5, as in *D. polysetum*, while *D. scoparium* and *D. undulatum* are monosetose. *Bartramia pomiformis* (F/O_1), growing on mesic cliffs, has a similar field aspect as *D. ontariense*, but is lighter green and its leaf margins are bi-stratose as observed with the 20x handlens. It has globose rather than curved-cylindrical capsules.

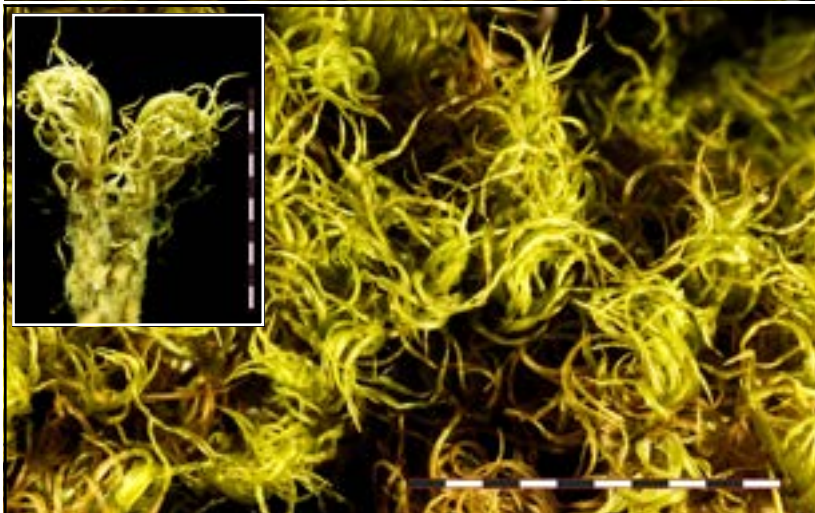
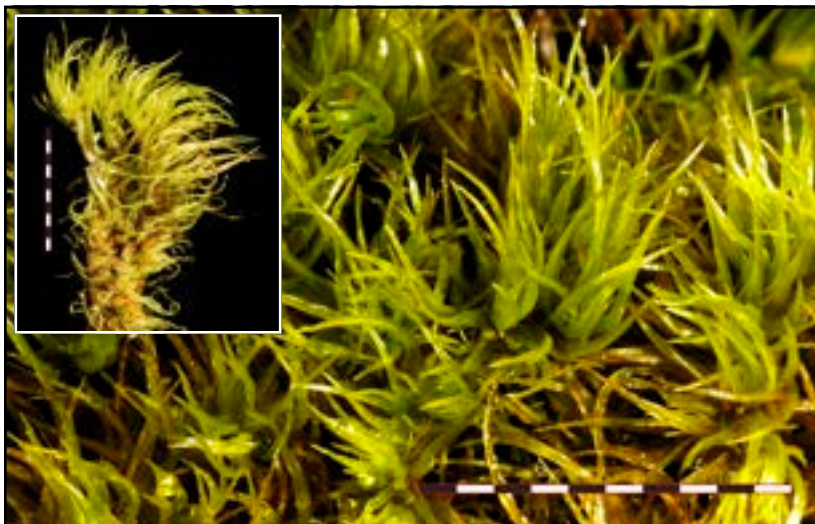
Associated Species: Mesohab: *Pleurozium schreberi*, *Ptilidium pulcherrimum*, *Dicranum polysetum*, *Callicladium haldanianum*, *Sphagnum magellanicum*, *Aulacomnium palustre*, *Sphagnum angustifolium*; Microhab: *Callicladium haldanianum*, *Hypnum pallescens*, *Plagiomnium cuspidatum*, *Platygyrium repens*; Pop: *Pleurozium schreberi*.



typical tall turf in coniferous woodland



DICRANUM ONTARIENSE



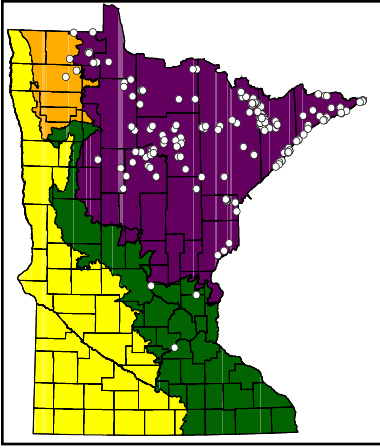
top: when wet the
falcate leaves are
sharply acuminate

middle: when dry the
leaves are crisped
and wavy

below: tomentum
usually dirty-white to
yellow-brown, rarely
brown



DICRANUM POLYSETUM



Abundance: Common (C_{17}).

Habitat and field aspect: Common in northern and central dry to mesic conifer and mixed forest and woodland. Frequent in northern spruce bog and poor conifer swamp, somewhat less in open bog, and poor and transitional fen. In northern and northwestern forested rich peatland commonly associated with black spruce, less with tamarack and cedar, rarely with alder. Recorded along Lake Superior rocky shore, in northern wet conifer forest, and northern mesic felsic cliff. Large patches are most often found on organic litter on the forest floor, rarely on mineral substrate, in quite dry microhabitat. It also occurs on fallen logs, equally frequent on bark as on recently exposed wood. Small clones or even single plants can be found scattered among other bryophytes.

Aid to identification: The plants are **highly glossy**, and the leaves **strongly undulate**. With the 20x handlens the **very sharp teeth of the serrated margins** are obvious, and even the **long-linear upper cells**, which cause the glossiness, are visible. Many **leaves are often straight** rather than falcate-secund, **nearly spreading** ($>45^\circ$ angle) from the stem, which is covered typically by a **dense white to greenish-white tomentum**.

Look-Alike Species: The other three large *Dicranum* species, *D. ontariense* (C_{12}), *D. scoparium* (C/F_{16}), and *D. undulatum* (F/C_{15}), also form large clones, but their individual plants are generally a bit smaller. None have the high gloss of *D. polysetum*. The leaves of *D. polysetum* are more highly undulate than those of the others, and often straight rather than falcate-secund as is typical for the genus. The tomentum is nearly always white, even when older; in the other species usually brownish on mature plants. Most diagnostically are the very long upper leaf cells and the associated sharp serrations, visible with the 20x handlens: those of *D. ontariense* and *D. undulatum* are short, giving the plants a more matte aspect. *Dicranum scoparium* has elongated upper leaf cells, but the leaves are more typical falcate-secund and show two distinct abaxial costal lamellae, again visible with the 20x. It also is monosetose (the sporophytes occur singly), rather than the polysetose *D. polysetum*. No other large and tall-turf acrocarp has the translucent glossy aspect and strongly undulate leaves of *D. polysetum*.

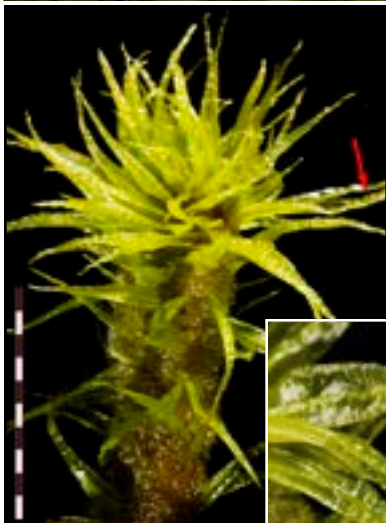
Associated Species: Mesohab: *Pleurozium schreberi*, *Ptilidium pulcherrimum*, *Callicladium haldanianum*, *Aulacomnium palustre*, *Sphagnum magellanicum*, *S. angustifolium*; Microhab: *Callicladium haldanianum*, *Plagiomnium cuspidatum*, *Hypnum pallescens*, *Platygyrium repens*; Pop: *Pleurozium schreberi*.



large clones on coniferous litter



DICRANUM POLYSETUM

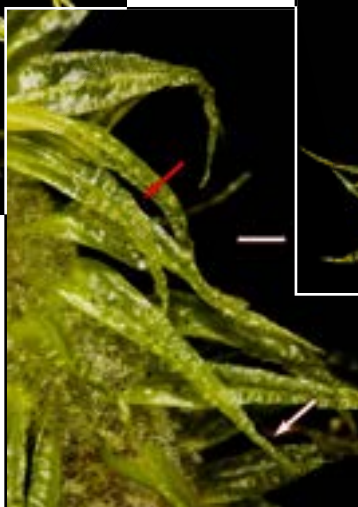
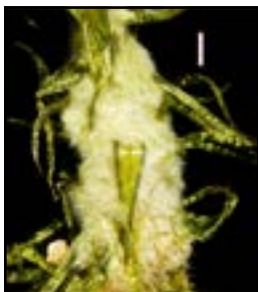
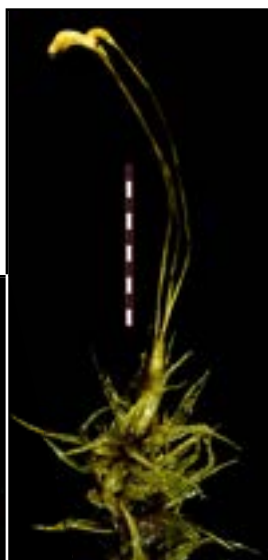


above and left: highly glossy, translucent and strongly undulate leaves, often spreading rather than falcate-secund when plants are wet

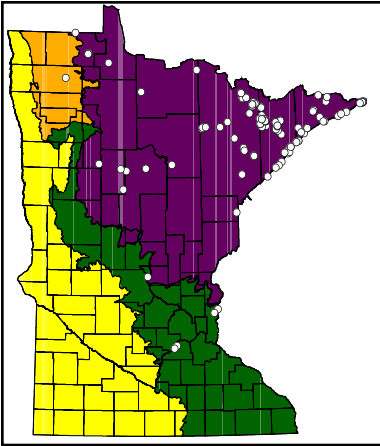
below left: dense tomentum usually white (when dry) on younger stems

left and below middle: all leaves strongly undulate (red arrow) and with sharp marginal teeth (white arrow)

right : setae clustered



DICRANUM SCOPARIUM



Abundance: Common/Frequent (C/F₁₆).

Habitat and field aspect: Common in northern mesic mixed fire-dependent forest and along Lake Superior rocky shore. Frequent in other northern and central fire-dependent woodland classes, northern mesic hardwood forest, and in northern cedar/fir and rich spruce swamps. Occasional in northern rich tamarack and poor conifer swamp, wet conifer forest, and on northern cliff. Recorded from northern rich and extreme rich fen. Most commonly encountered on humus of forest floor, but also on coarse woody debris, and covering exposed rocks. Usually forms **small to medium-sized turfs**.

Aid to Identification: The plants are **moderately glossy**, usually with **typical falcate-secund leaves** (broom moss). With the 20x handlens two **sharply serrate abaxial costal lamellae or ridges** can often be discerned. **Tomentum**, when somewhat older, is **usually brown**. Sporophytes are found singly on the female plant (**monosetose**).

Look-Alike Species: *Dicranum scoparium* is similar in size as *D. ontariense* (C₁₂), *D. polysetum* (C₁₇), and *D. undulatum* (F/C₁₃). It is distinguished by its more typical *Dicranum*-type of leaf-curvature (falcate-secund). Its leaves, when dry, are far less twisted than those of *D. ontariense*, and in Minnesota specimens often not very distinctly undulate, certainly less so than those of *D. polysetum*. It shares the elongate upper leaf cells of *D. polysetum* (causing these plants to have a more glossy aspect), but the denticulation along the margins is far less pronounced. Other *Dicranum* species in Minnesota are smaller: medium (*D. fuscescens* F₇, and *D. fragilifolium* O₂), small (*D. flagellare* C₁₈ and *D. viride* F₈), or tiny (*D. montanum* C₁₄). *Dicranum bonjeanii* (U₁) and *D. fulvum* (U₂) have to be differentiated on technical, microscopic characters. *Dichelyma falcatum* (O/U₃) and *D. pallescens* (U₂), species unrelated to the Dicranales, have a similar field aspect (but not undulate) as *D. scoparium*, but occur in aquatic environments, on rock in intermittent streams.

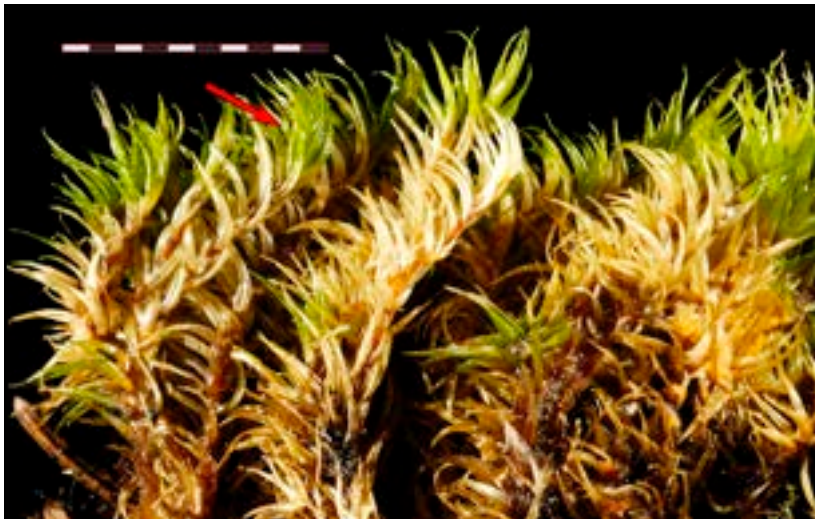


glossy tall turf with the distinctive falcate-secund *Dicranum*-type leaf curvature

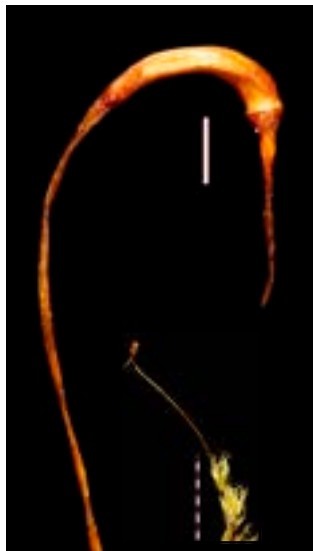
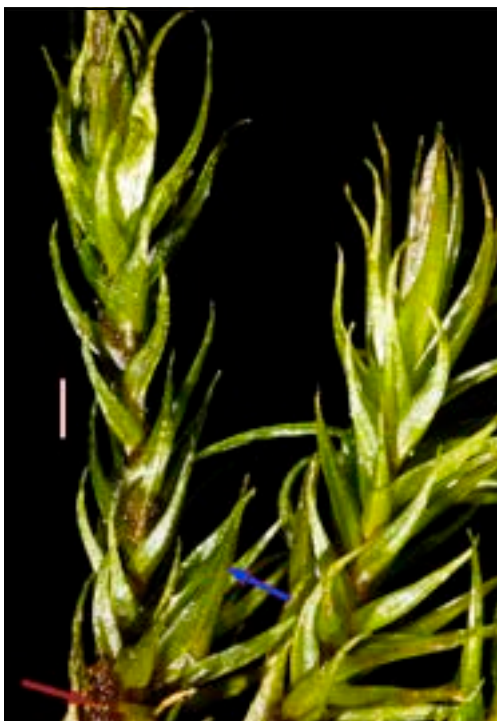


DICRANUM SCOPARIUM

Associated Species: Mesohab: *Pleurozium schreberi*, *Ptilidium pulcherrimum*, *Callicladium haldanianum*, *Sanionia uncinata*; Microhab: *Callicladium haldanianum*, *Plagiomnium cuspidatum*, *Hypnum pallescens*, *Platygyrium repens*; Pop: *Pleurozium schreberi*, *Sanionia uncinata*, *Callicladium haldanianum*.



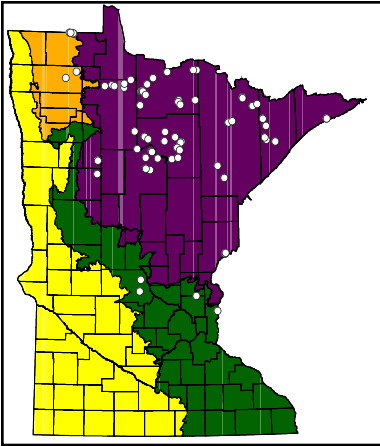
distinctive falcate-secund *Dicranum*-type leaf curvature, seen in profile when a tall turf is broken open



left: glossy leaves, often only faintly undulate; when carefully studied with the 20x handlens the abaxial costal ridges are visible (blue arrow); tomentum usually brown (brown arrow) except sometimes in the youngest parts

above: monosetose, only a single sporophyte produced per plant; the operculum is long-rostrate

DICRANUM UNDULATUM



Abundance: Frequent/Common (F/C₁₅).

Habitat and field aspect: Common in northern rich spruce and tamarack swamp. Frequent in northern spruce bog and poor conifer swamp. Occasional in northern rich (water track), transitional, poor, and shrub shore fen, and northwestern rich conifer swamp. Recorded from northern alder swamp, open bog, and wet conifer forest. **Small to medium-sized rounded and often domed tall turfs** among *Sphagnum* hummocks and underneath conifer trees on peat.

Aid to Identification: The plants have **stiff, upright and erect-appressed leaves** and are **densely packed** in their turf. The medial and upper cells are short, and give the plants a **matte aspect** when dry. **Brown tomentum**.

Look-Alike Species: Very similar to *D. ontariense* (C₁₂), from which it has been only lately differentiated, but its leaves are not as curly nor twisted when dry. Also nearly always associated with peatland mesohabitat, while *D. ontariense* is often found on a dry forest floor of fire-dependent woodland. A technical but reliable distinction involves the leaf apex (20x handlens): in *D. undu-*

latum it is blunt when compared next to the one of *D. ontariense*, but some familiarity with this character is needed. Again, as is the case with *D. scoparium* (C/F₁₆), the leaves of Minnesota specimens are often not as undulate as suggested by the standard literature. The other large *Dicranum* species, *D. polysetum* (C₁₇) and *D. scoparium*, are glossy and are either strongly undulate with sharply serrate leaves (*D. polysetum*) or with falcate-secund leaves and abaxial ridges (*D. scoparium*).

When well-developed, it is bigger than most acrocarpous non-*Dicranum* species, but it might look somewhat similar in color and matte aspects to another common peatland species, *Aulacomnium palustre* (C₂₂), with which it is commonly associated. The latter rarely has its stems in the dense upright packing of *D. undulatum*, however, and has a blackish rather than brown tomentum.

Associated Species: Mesohab: *Aulacomnium palustre*, *Pleurozium schreberi*, *Sphagnum angustifolium*, *S. magellanicum*; Pop: *P. schreberi*, *A. palustre*, *D. polysetum*, *S. angustifolium*.



dense turf as part of a *Sphagnum magellanicum* hummock in shade of large spruce tree

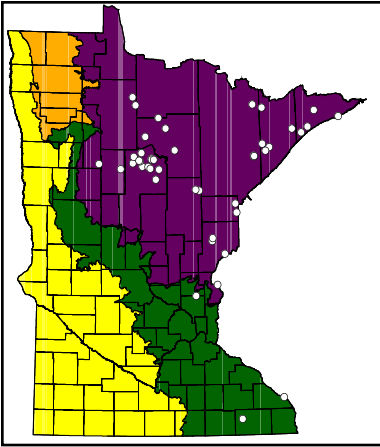


DICRANUM UNDULATUM



fairly straight, upright leaves with a relative blunt apex (compared with the one of *D. ontariense*)

DICRANUM VIRIDE



Abundance: Frequent (F_{14}).

Habitat and field aspect: Frequent in northern wet forest. Occasional in northern hardwood (cedar) forest, and rich spruce and cedar/fir swamp. Recorded from northern alder swamp, mesic mixed forest, rich fen, and southern open talus. **Dark-green, matte, and small clones** on bark of tree trunks and large branches, and on coarse woody debris, rocks, and humus.

Aid to Identification: The **fragile**, easily broken off **leaf tips** are absolutely diagnostic among Minnesota *Dicranum* species: they can be easily observed when a small part of a clone is tapped upside down on the palm of the hand. Only the **younger, unbroken leaves are somewhat curved-secund**.

Look-Alike Species: *Dicranum* species, similarly of medium size, are *D. flagellare* (C_{18}) and *D. fuscescens* (F_7). These species are usually lighter green in color, and characterized by either flagellate branches, or more curved leaves and abundant light-colored tomentum.

Dicranum fragilifolium (O_1) has only been recorded in the North Shore Highlands along Lake Superior, and can

be definitely differentiated by its shiny rather than dull-matte aspect, and by its elongate upper leaf cells. The larger *Dicranum* species, *D. ontariense* (C_{12}), *D. polysetum* (C_{17}), and *D. scoparium* (C/F_{16}) are usually found on forest floor rather than on bark or wood, usually in more exposed and drier habitat. *Dicranum montanum* (C_{14}) occurs sometimes together with *D. viride*, but is strongly crisped when dry, and our smallest *Dicranum* species, *Dicranum undulatum* (F/C_{15}) might have a similar aspect as *D. viride* with its upright stems in dense turfs, but is much larger and the leaf tips are not fragile. It is also nearly restricted to peatland mesohabitat, and growing directly on peat. No non-*Dicranum* acrocarpous turf-forming moss has the fragile leaf tips found on *D. viride* except for *Tortella fragilis* (O_3): this species is very similar in field aspect, both wet and dry, but is found commonly on mineral substrate in xeric microhabitat. Its leaves are even more closely appressed, and (with the 20x handlens) show a long and hyaline basal part, extending up along the margins.

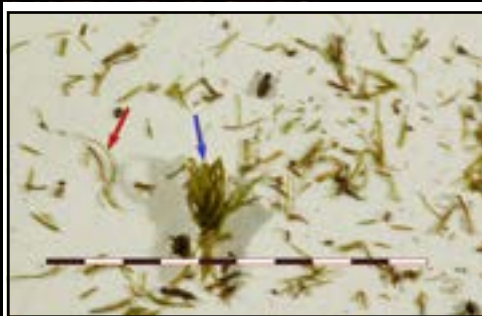
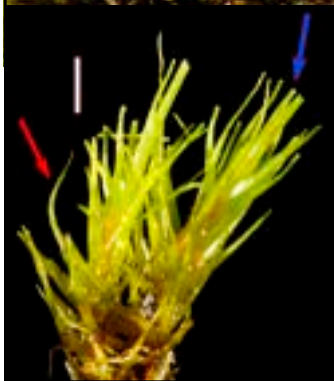
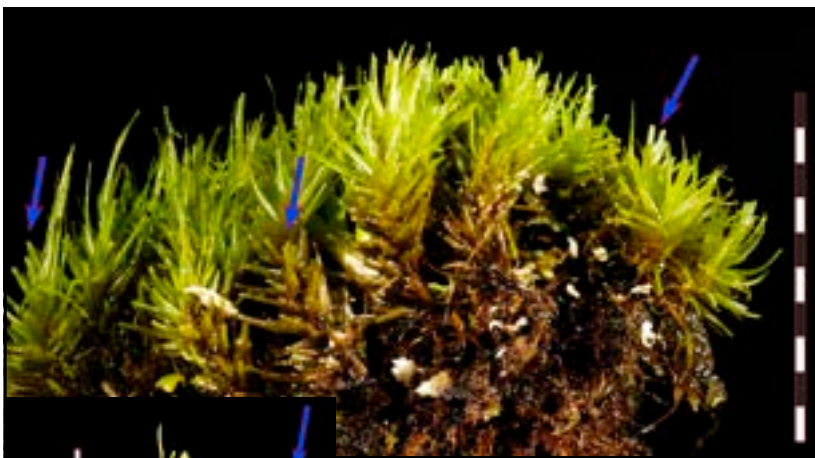


small clone of characteristic dark-green color and stiffly erect leaves, on rock along trail in a mixed upland forest



DICRANUM VIRIDE

Associated Species: Mesohab: *Plagiomnium cuspidatum*, *Callicladium haldanianum*, *Dicranum flagellare*, *Tetraphis pellucida*, *Platygyrium repens*; Microhab: *Callicladium haldanianum*, *Plagiomnium cuspidatum*, *Hypnum pallescens*, *Platygyrium repens*, *Brachythecium acuminatum*; Pop: *Platygyrium repens*, *Callicladium haldanianum*, *Sanionia uncinata*.



above: plants with stiffly erect leaves, many tips broken (blue arrows); middle: in profile the fragile leaf tips (or the absence thereof) is easily seen

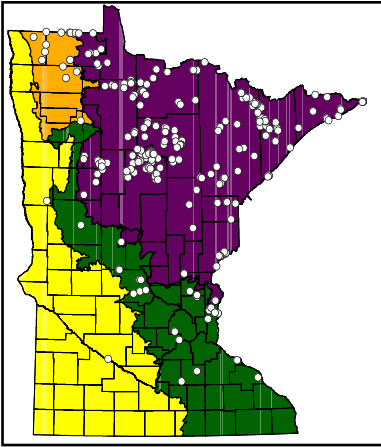
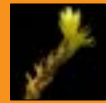
below left: the characteristic curved-second leaf shape of a *Dicranum* species is only seen in some of the younger, unbroken leaves (red arrow)

below right: tapping some plants tip down on a surface will produce many broken leaf apices



OTHER ACROCARPS

AULACOMNIUM PALUSTRE



Abundance: Common (C₂₂).

Habitat and field aspect: Common in all classes of northern acid, and in northern, northwestern, and southern forested rich peatland, except less in northern cedar/fir swamp. Frequent in northern rich and extreme rich fen and shrub shore fen. Occasional in northern wet and southern seepage meadow/carr. Recorded from prairie extreme rich fen, northern wet conifer forest and northern and southern wet ash swamp, northern and northwestern fire-dependent forest and woodland, and central mesic hardwood forest. Found **scattered as small clones or individual plants** among other species of bryophytes, frequently *Sphagnum* on medium to high hummocks. **Under dense shrub** cover sometimes forming **larger pure populations** above the local water table. The plants grow vigorously **in the spring** and then are **bright green**, but in the fall usually become **darker green when growth stops** and the dense dark tomentum along the stems becomes more evident.

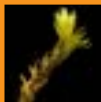
Aid to Identification: Sparsely **branched by innovation**, with **unbordered lanceolate leaves** (but with partly

narrowly-recurved margins) that are **wavy and somewhat crinkled when dry**. Dry plants with a **matte aspect** (because of short and papillose cells). The **tomentum is brown to black (arrow)**, and **covers most of the stem**. Sometimes long extending **stalks are formed with gemmae clustered at the top**. The mature **capsules on tall setae are inclined horizontally, castaneous-brown and grooved when mature**.

Look-Alike Species: No other peatland acrocarp has the combination of matte aspect, narrowly lanceolate leaves, crinkly when dry, gemmae stalks, and abundant dark-brown tomentum. *Ptychostomum pseudotriquetrum* (C₂₂) and *P. creberrimum* (O₁₀) leaves are distinctly bordered. *Pohlia nutans* (C₁₈) plants often grow scattered among *Sphagnum*, as those of *A. palustre*, but are smaller without abundant tomentum. Among smaller look-alikes, *Ceratodon purpureus* (C/F₂₂) has a glossy brown and grooved mature capsule, but is an upland plant with narrowly recurved margins along the leaves, which are strongly crisped when dry. *Orthotrichum obtusifolium* (F₁₈) grows as small cushions on twigs, with blunt leaf tips. *Catospodium nigrum* (O₁) grows along pool edges of extreme rich fens and has stiffly erect-spreading leaves, distinctly arranged in three longitudinal rows. *Hymenostylium recurvirostrum* (O₇) is usually found in calcareous seeps and forms dense bulging cushions. *Leptobryum pyriforme* (F₁₄), with very thin, setaceous leaves, is frequently scattered unobtrusively among other wetland bryophytes.

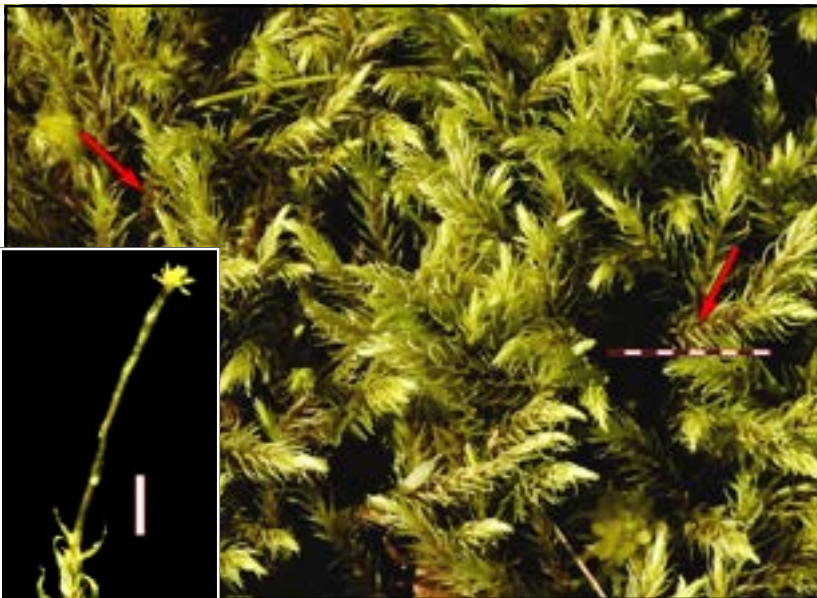


well-developed clone on high *Chamaedaphne* hummock in small prairie pothole *Sphagnum* poor fen



AULACOMNIUM PALUSTRE

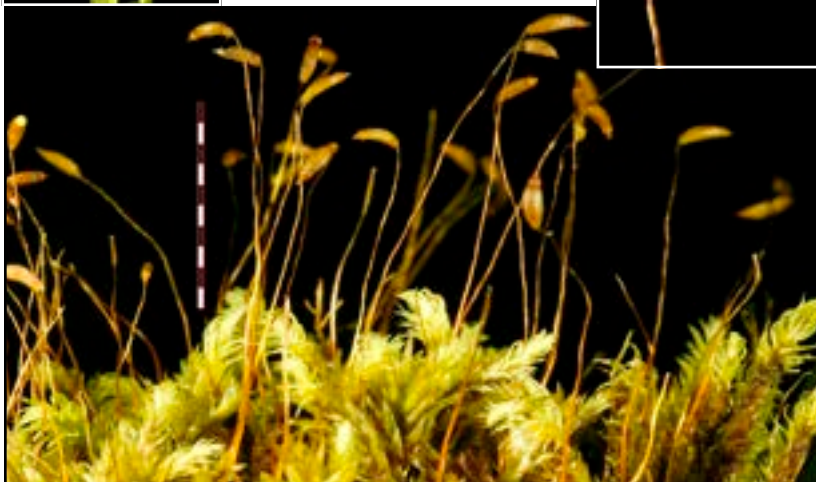
Associated Species: MesoHab: *Sphagnum magellanicum*, *S. angustifolium*, *Pleurozium schreberi*, *Polytrichum strictum*, and *Callicladium haldanianum*; Pop: *S. angustifolium*, *Pleurozium schreberi*, and *S. magellanicum*.



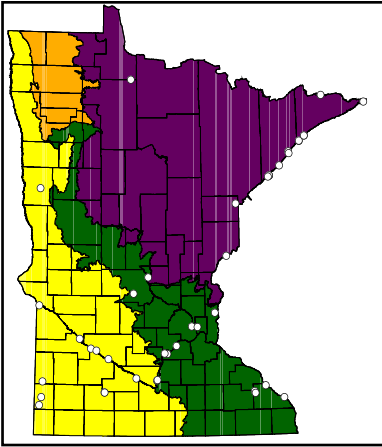
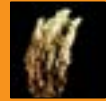
above: somewhat darker more mature clone (brown tomentum, see arrows)

left: single plant with gemmae stalk

below and right: mature sporophytes on long setae with horizontally inclined and, when mature, grooved castaneous-brown colored capsules



BRYUM ARGENTEUM



Abundance: Frequent/Occasional (F/O₁₃).

Habitat and field aspect: Frequent along wet rocky shore (Lake Superior). Occasional in southern wet and dry upland prairie, and on southern bedrock outcrop and open talus. Recorded from northern wet prairie and clay/mud river shore. Most often recognized when growing in fissures on rock outcrops. Also found as small clones in turfs among other small acrocarps and in smooth mats of tightly adhering pleurocarps. Most likely under-reported, as this species is nearly cosmopolitan and one of the most toxi-tolerant. It should be expected in all urban environments and ruderal microhabitats. Easily spotted by the **whitish-silvery aspect** of its short turfs.

Aid to Identification: The **leaves are hyaline** (without chlorophyll) **at the apex** (often with a long apiculus), **sometimes for their entire upper part**. They are **closely appressed even when wet**, and the **small plants** (about 10 mm high) **are poorly branched and densely packed**.

Look-Alike Species: Other acrocarps with a silvery aspect have long-excurrent costae as hyaline awns, with little of the leaf lamina being clear. Nearly all of them are larger plants. *Syntrichia ruralis* (F/O₇) has strongly twisted leaves when dry, squarrose-recurved when wet. Its hyaline awns are distinctly offset from the rest of the leaf. *Rosulabryum capillare* (F₁₄) is larger and has a cluster of larger leaves at the tip of the stems. The leaves are not abruptly hyaline at the tips. Both *Grimmia laevigata* (F/U₆) and *Hedwigia ciliata* var. *ciliata* (C/



short turf on mineral substrate

Other Acrocarps

June 2016



BRYUM ARGENTEUM

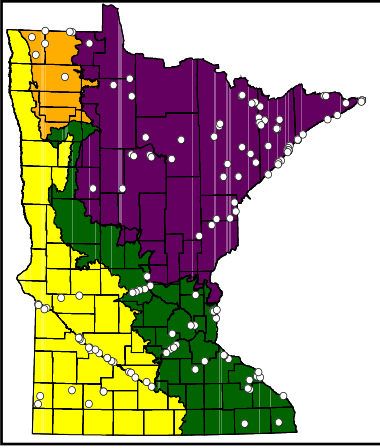
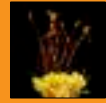
F₁₆) have hyaline upper leaf parts. The rest of the plant, however, is very dark in *G. laevigata*, and the leaves become spreading-erect when wetted. The leaves of *H. ciliata*, also spreading when wet, lack costae, and the turfs have somewhat of a pleurocarpous aspect. The only other mosses with an entirely whitish light-green aspects are either *Sphagna*, or *Leucobryum glaucum* (F₁₃). *Sphagnum* species are easily differentiated by their very characteristic stem and branching structure. *Leucobryum glaucum* is a lot larger than *B. argenteum*, and its leaves have a fleshy look and are entirely light colored. A few other species with an atypical color aspect are *Saelania glaucescens* (U₁) with a waxy coat on the dry leaves, and *Pohlia wahlenbergii* (O₂) with a milky-white aspect. Neither species has the tightly appressed leaves of *B. argenteum*.

Associated Species: MesoHab: *Ceratodon purpureus*, *Weissia controversa*, *Amblystegium serpens*, *Hedwigia ciliata* var. *ciliata*; Pop: *Ceratodon purpureus*, *Mannia fragrans*, *Syntrichia ruralis*.



the red arrow points to the tip of a broken stem, exposing an ovate-lanceolate leaf with a hyaline upper part; both the older leaves and the upper halves of the younger leaves are without chlorophyll and produce the silvery aspect of the clones

CERATODON PURPUREUS



Abundance: Common/Frequent (C/F₂₂).

Habitat and field aspect: Common along Lake Superior and inland lake rocky shore, and on southern bedrock outcrop. Occasional in northern poor fen, wet meadow/carr, and alder swamp. Recorded in many other native plant community classes such as northern and north-western swamps and fire-dependent forest/woodland, northern and southern mesic hardwood forest, prairie, and savanna, and northern rich fen. Small to extensive turfs, usually associated with local disturbance (**ruderal microhabitat**), such as burns, trampling, and road cuts or trail banks, but also **growing on exposed rocky or sandy surfaces** in a natural setting. Its distribution is more widespread than the map suggests, as most sites in highly disturbed and urban habitat are ignored. During the spring the extensive turfs with **young sporophytes are characteristically reddish-purple. Later in the growing season they become castaneous-brown.**

Aid to Identification: The gametophores are extremely non-descript and variable: this species is one of the hardest to recognize when sterile, until you become

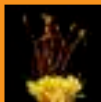
attuned to it, or study it under the compound microscope. When **dry the plants are a dull dark-green to brown, frequently yellowed in patches, with incurved leaves.** When **wet the leaves are lanceolate and erect-spreading, with revolute margins that reach nearly to the apex.** Fortunately **the species nearly always produces abundant sporophytes** which persist for a long time. **Mature capsules are horizontally inclined, slightly curved and narrowly cylindrical, and when old deeply furrowed and glossy brown.** The **setae of the young capsules in spring are definitely purplish-tinted en masse**, but this stage is short-lived.

Look-Alike Species: Many other small-stature acrocarpous mosses have a similar aspect. Most of these be-

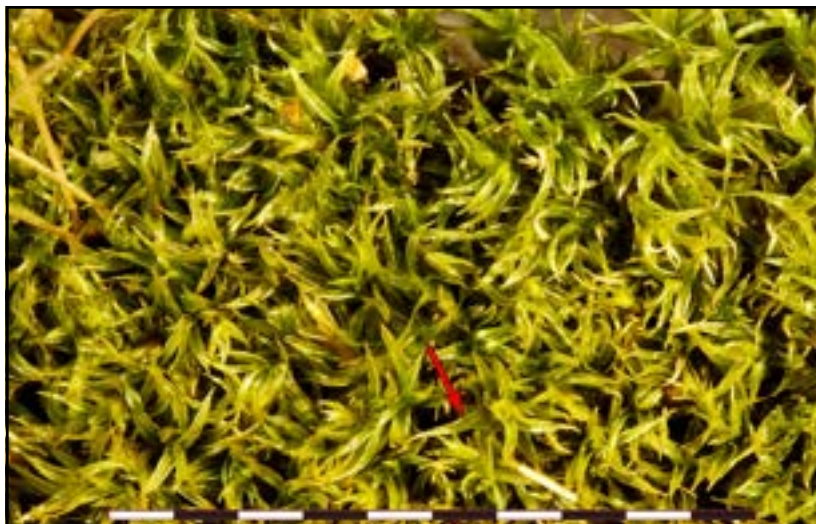


long to the family of the Pottiaceae, commonly also found in xeric microhabitat. Many species have distinctive papillae on the laminal cells, absent in *Ceratodon purpureus*. However, these can only be observed with a compound microscope, but cause the plants to look matte. Another small acrocarp with prolific sporophyte production in ruderal microhabitat is *Funaria hygrometrica* (F/O₁₆). Its capsules are pear-shaped, with a oblique mouth and the setae that support them are graciously curved and twist when the local air humidity changes.

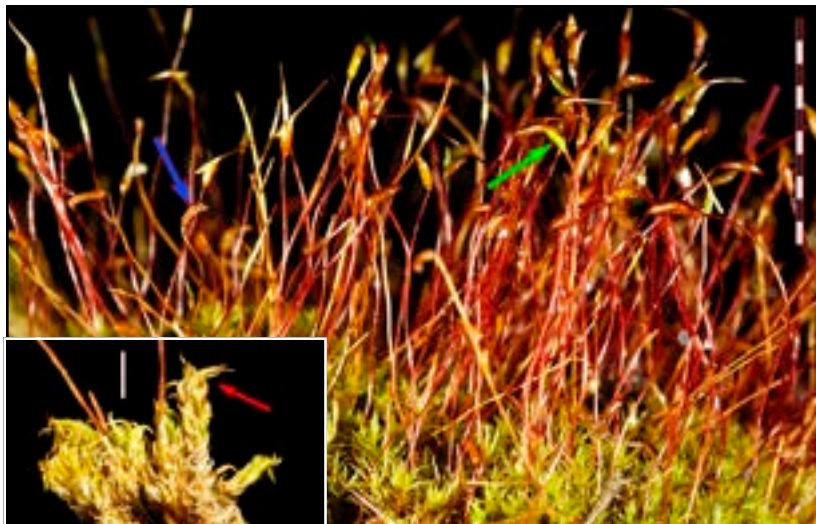
Associated Species: MesoHab: *Plagiommium cuspidatum*, *Callicladium haldanianum*, *Aulacomnium palustre*, *Platygyrium repens*, *Brachythecium salebrosum*; Pop: *Plagiommium cuspidatum*, *Polytrichum piliferum*, *Pohlia nutans*, *Hedwigia ciliata* var. *ciliata*, *Brachythecium salebrosum*, *Ptychostomum pseudotriquetrum*.



CERATODON PURPUREUS



when wet the leaves are erect-spreading, lanceolate and narrowly acuminate, with revolute margins (arrow)



above: abundant sporophytes, capsules immature (green arrow), mature (brown arrow), or old (blue arrow)

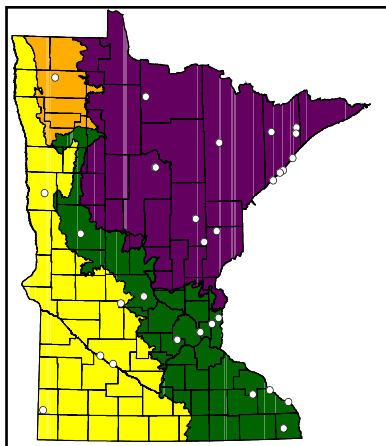
far left: dried plants with incurved but not strongly crisped leaves

left: old, mature capsules, narrowly cylindric and deeply furrowed

Other Acrocarps

June 2016

FUNARIA HYGROMETRICA



Abundance: Frequent/Occasional (F/O₁₀).

Habitat and field aspect: Frequent in disturbed (ruderal) microhabitat, usually associated with recent fire. In natural plant communities occasional found in northern wet meadow/carr. Also recorded from northern wet prairie and patterned rich spruce swamp, and prairie mixed cattail marsh and rich fen. Extensive turfs are found associated with charcoal, such as old fire rings on campgrounds. Otherwise the species is found as small clones in recently disturbed microhabitat, such on top of broken-off alder trunks in swamp. Recognized easily when **producing prolific numbers of sporophytes**.

Aid to Identification: The **vegetative plants are very small**, and when dry nearly impossible to see. When wet the **leaves are ovate to obovate, highly transparent because of the large, thin-walled cells, and with a long apiculus**. The sporophytes are highly characteristic, with a **strongly asymmetric pear-shaped capsule with oblique mouth, brown to dark-brown when mature**

and furrowed when old. The capsules are supported by very **long, cygneous setae** (often > 5-cm tall) **which twist when the local air humidity changes**.

Look-Alike Species: No other species of the genus have been recorded for Minnesota, except for *Funaria americana* (no abundance estimate). The setae in this species are much shorter (6-10 mm) and the capsules are smooth. Many other species in the order of the Funariales have a similar leaf structure as that of *Funaria hygrometrica*, and sporophytes are thus nearly always necessary for positive identification. When mature sporophytes are present, this species is easily recognized.

Associated Species: MesoHab: *Ptychostomum pseudotriquetrum*, *Leptobryum pyriforme*, *Plagiomnium ellipticum*, *Drepanocladus aduncus*, *Campylium stellatum*; Pop: *Ptychostomum pseudotriquetrum*, *Leptobryum pyriforme*, *Hygroamblystegium varium* mod. 'varium'.



large population marking the site of an old campground fire, also with patches of *Ceratodon purpureus*



FUNARIA HYGROMETRICA



close-up of the numerous sporophytes with twisted setae, note the small size of the gametophores compared with the sporophytes; the capsules range from immature green ones to mature old ones with wrinkled theca (arrow)

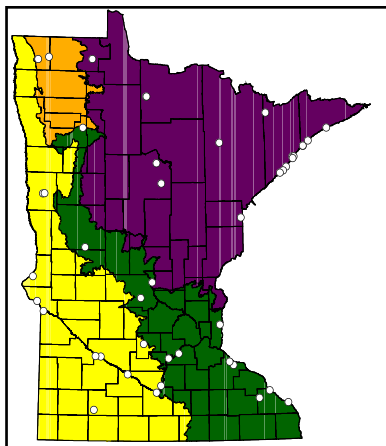


immature capsules, pear-shaped and with an oblique mouth of *Funaria hygrometrica*; most of the green plants in the picture are actually *Ceratodon purpureus* which is overtopping the fertile *Funaria hygrometrica* gametophores carrying the sporophytes

Other Acrocarps

June 2016

GEMMABRYUM CAESPITICIMUM



Synonym: *Bryum caespiticium*.

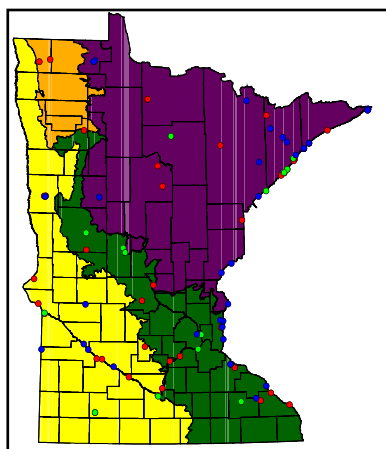
Abundance: Frequent/Occasional (F/O₁₀).

Habitat and field aspect: Frequent in northern and southern wet and mesic prairie, and along Lake Superior rocky shore. Occasional in northern rich-fen water track and extreme rich fen, and in northern patterned rich spruce swamp. Recorded from southern bedrock outcrop and open talus, and from northern wet meadow/carr. Growing as **small clones in short turfs**, or scattered among other low-stature bryophyte populations.

Aid to Identification: Vegetatively appearing as a typical *Bryum s.l.*, with the **upper leaves quite enlarged and clustered at the tip of the stem (comose)**. Critical identification depends on the presence of mature, well developed sporophytes.

Look-Alike Species: *Bryum sensu lato* is a large genus worldwide, and it is hard to tell how many species we actually have represented in Minnesota: most material collected during ecological surveys is sterile. Species

that I have attempted to recognize routinely and that are similar in appearance and often occur in ruderal settings are *Ptychostomum creberrimum* (O₁₀) and *Rosulabryum capillare* (F₁₄). Only the position of gametangia and the structure of the peristome can be used to good effect in differentiating these species from *Gemmabryum caespiticium*. Character states of the gametophores that might differentiate the three species in well developed specimens are the long-excurrent costae of *R. capillare* and the strongly differentiated and revolute leaf border in both *R. capillare* and *P. creberrimum*. The three species mentioned so far, when sterile, might thus very easily be confused with each other, and this is most likely also reflected in their joint distribution map below:



distribution of the tentative identifications of small *Bryum s.l.* species in MN:

red = *Bryum* (*Gemmabryum*) *caespiticium*

green = *Bryum lisae* var. *cuspidatum* (*Ptychostomum creberrimum*)

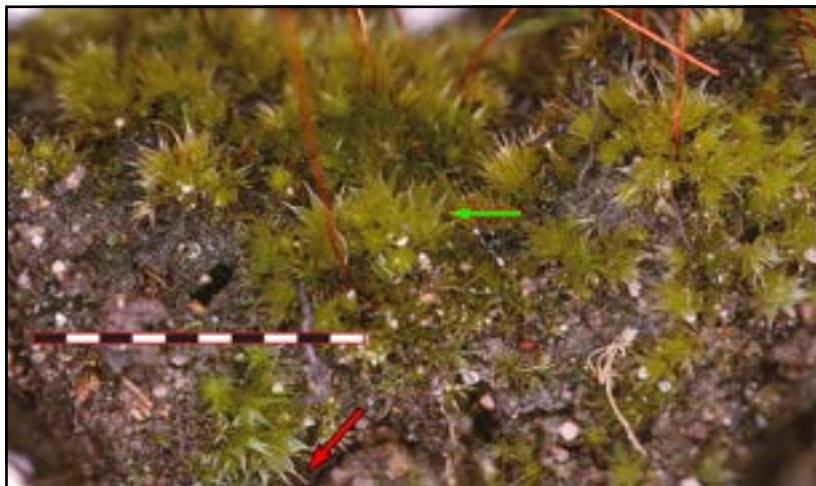
blue = *Bryum* (*Rosulabryum*) *capillare*

The one species of *Bryum s.l.* that is usually easily distinguished in the field from the three small species discussed above is the very common wetland species *Ptychostomum pseudotriquetrum* (C₂₂). Its red stems are easily visible because of elongated internodes between the leaves. The leaves are distinctly decurrent, and dark or protonematous rhizoids are often present. *Pohlia nutans* (C₁₈) could have a similar field aspect as *Bryum s.l.*, but its leaves are narrowly linear-lanceolate rather than ovate-lanceolate, and not bordered by differentiated cells.

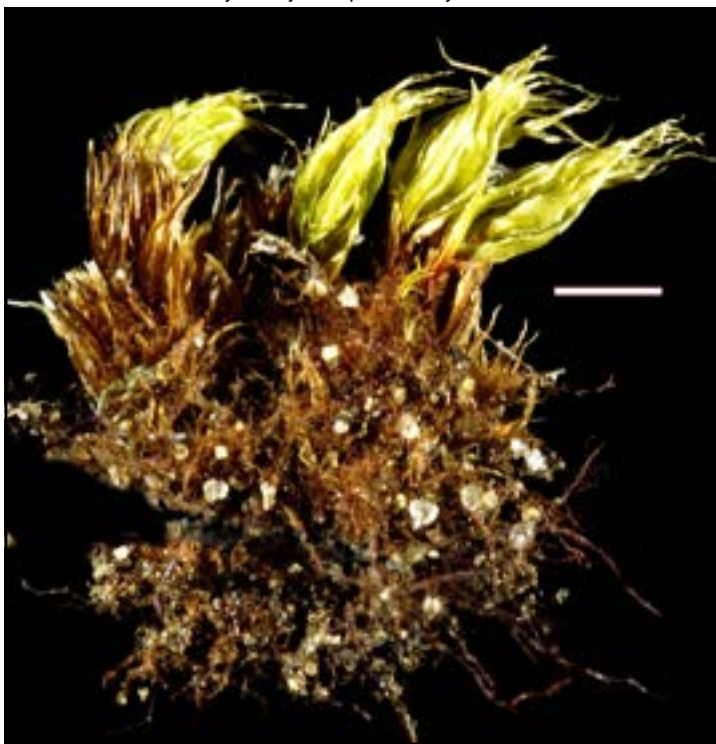
Associated Species: MesoHab: *Ptychostomum pseudotriquetrum*, *Campyliadelphus chrysophyllus*, *Callicladium haldanianum*; MicroHab: *Callicladium haldanianum*, *Plagiomnium cuspidatum*, *Brachythecium erythrorrhizon*, *Sciuro-hypnum reflexum*, *Hypnum pallescens*; Pop: *Weissia controversa*, *Tortella humilis*, *Dicranella varia*, *Schistidium apocarpum*.



GEMMABRYUM CAESPITICIUM

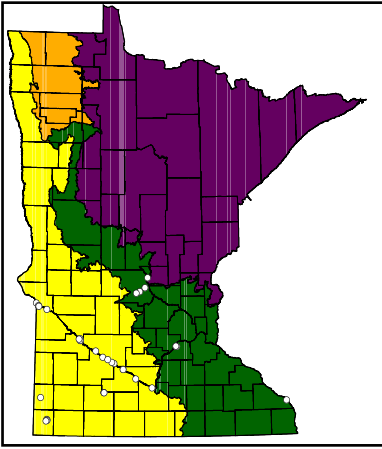


usually growing on mineral substrate; note the long narrow apiculus (red arrow) and bordered leaf margins (green arrow); many small *Bryum* s.l. species look very much alike



the small plants are comose (upper leaves enlarged and clustered); the red stem is only visible below; the leaves are somewhat contorted and twisted when dry, very glossy; they are not obviously decurrent; specimens with more abruptly ovate lanceolate leaves with long excurrent costae might be *Bryum* (*Rosulabryum*) *capillare*; those with a strongly differentiated and revolute border might be *Bryum* *lisae* var. *cuspidatum* (*Ptychostomum* *creberrimum*)

GRIMMIA LAEVIGATA



Abundance: Frequent/Uncommon (F/U₆).

Habitat and field aspect: Found on southern bedrock outcrop. **Small gray (dry) to green (wet) cushions** on xerophytic rock outcrop.

Aid to Identification: The length of the **hyaline awns** is quite variable, but most characteristic is the **rounded back (abaxial surface) of the leaves (not keeled)** and **the extension of the hyaline awn (decurent)** along the upper margins of the leaves.

Look-Alike Species: Similar to *Schistidium apocarpum* (F₁₂), *Grimmia pilifera* (F/U₇), and *Jaffuelobryum wrightii* (R₁). Their leaves, as well of those of other *Grimmia* species with hairpoints, are distinctly keeled, and the awns are not decurrent. There are many other potential look-alike species with a small acrocarpous stature and silvery aspect, also including species of other genera within the family Grimmiaceae. The Minnesota distribution of most of these is poorly know, as many records are in need of critical re-evaluation. Characters of the mature sporophyte are critical for proper identification.

Other species with long hyaline awns belong to the family of the Pottiaceae. The Minnesota species, such as *Syntrichia ruralis* and *Tortula muralis*, do not have the wide decurrent base to the hairpoint as in *Grimmia laevigata*, and their costae are more pronounced.

Associated Species: MesoHab: *Syntrichia ruralis*, *Hedwigia ciliata* var. *ciliata*, *Ceratodon purpureus*, *Bryum argenteum*, *Brachythecium acuminatum*.



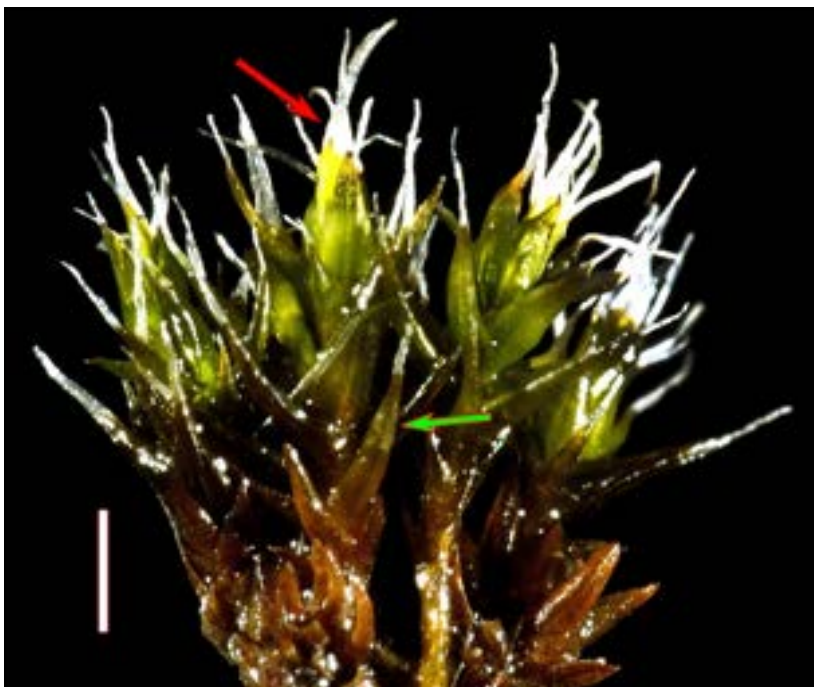
medial section through a small cushion, showing the radial arrangement of the plans and the branching by innovations (red arrow points to the hyaline awns)



GRIMMIA LAEVIGATA

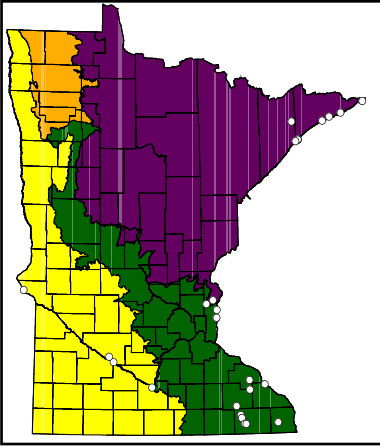
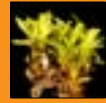


contrast between dry (above) and wet (below) habit (left and clone (right)



a few plants (wetted), removed from a small cushion, showing the decurrent hairpoints (red arrow) and the smooth abaxial surface of the leaf (green arrow)

GYMNOSTOMUM AERUGINOSUM



Abundance: Frequent (F_6).

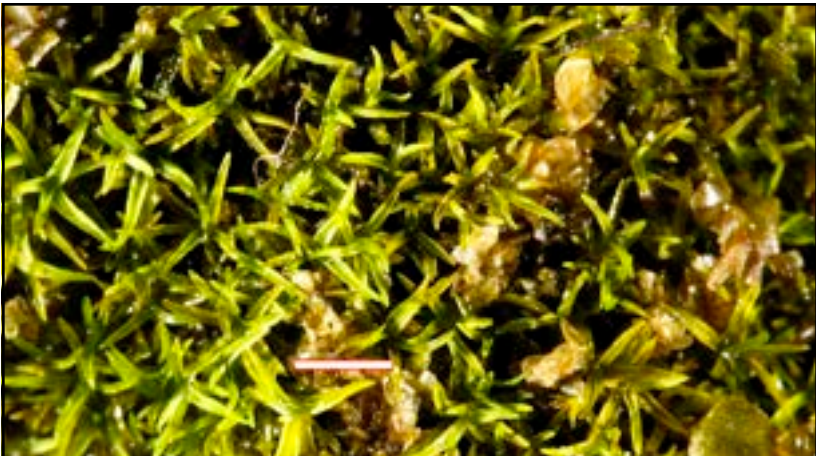
Habitat and field aspect: Frequent on southern mesic cliff and open talus. Occasional on northern wet cliff and along Lake Superior rocky shore. Recorded from southern dry-mesic oak forest, wet cliff, algific slope and moderate cliff, and from northern mesic cliff. Often covering large expanses of calcareous cliff face with a smooth short turf. The large bulging cushions only form when the population has been able to be attached to the substrate for a long time and has grown outward for many years: in seepage the older stems are often encrusted and supported by CaCO_3 .

Aid to Identification: Small acrocarpous moss (5 mm high, but sometimes up to 40 mm when growing for a long time) with little individual-plant character: the **leaves are curled and twisted when dry, and rapidly become spreading-recurved when wetted**. There is **no evidence of either a border or a recurved margin** (20 x handlens). The leaf apices are often somewhat

blunt. The **capsules** are frequently found and **have no peristome**.

Look-Alike Species:

The look-alike eperistomatic *Hymenostylium recurvirostrum* (O_7), which grows in similar mesohabitat (25% co-occurrence), is somewhat larger and has partly or one-sided recurved leaf margins and more pointed leaf apices.

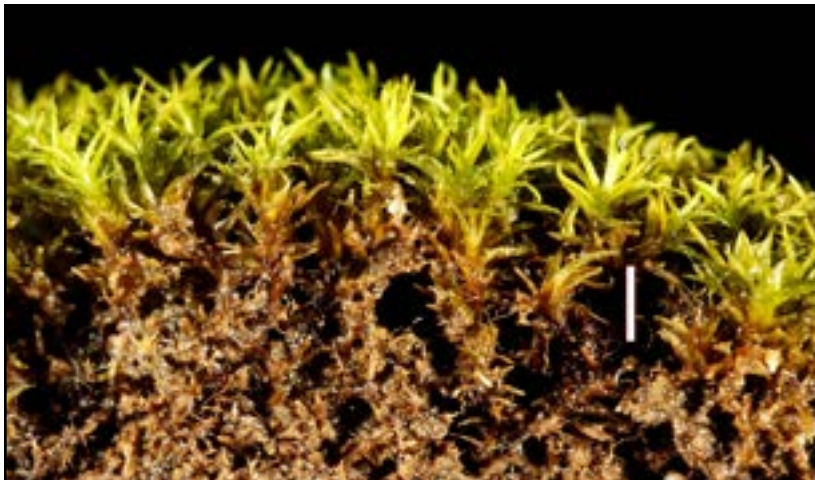


large bulging cushions (above); strap-like, spreading-recurved leaves, matte and without evident border or folded margins



GYMNOSTOMUM AERUGINOSUM

Associated Species: MesoHab: *Plagiomnium cuspidatum*, *Anomodon rostratus*, *Myurella sibirica*, *Brachythecium acuminatum*, *Anomodon attenuatus*, *Conocephalum salebrosum*; Pop: *Myurella sibirica*.

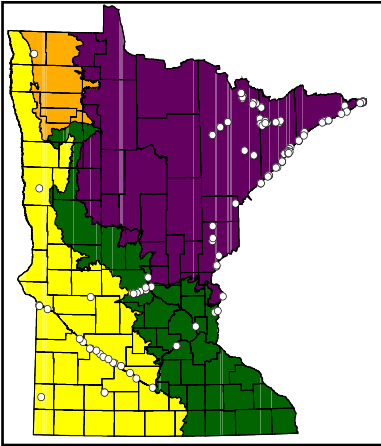


plants can get quite tall when growing for a long time on more stable rock substrate



peristomes are absent

HEDWIGIA CILIATA



Abundance: Common/Frequent (C/F₁₆).

Habitat and field aspect: Common along Lake Superior rocky shore. Frequent on northern cliff and southern cliff and talus. Occasional on southern bedrock outcrop, and northern bedrock woodland and in conifer forest. Recorded from northern and central terrace, mixed, and hardwood forest, and poor conifer swamp. Nearly always found on exposed large rocks. Traditionally classified among the acrocarps, but with a distinct pleurocarpous **rough-mat or sometimes even a weft-like aspect**. When **dry the color of the patches is a matte gray**, but **when wetted, the plants rapidly expand and the large clones become suddenly a light bright-green**.

Aid to Identification: The broadly **ovate-lanceolate leaves are ecostate with a hyaline upper part and long apiculus**. **Sporophytes** are common, but **sessile** (without obvious setae) and **hidden among a cluster of leaves with long cilia**.

Look-Alike Species: Most similar in field aspect and microhabitat are species of *Racomitrium* s.l. with hyaline awns (*Bucklandiella heterosticha* U., and *B. microcarpa*

O/U₃). However, they have distinctly costate, more narrowly lanceolate leaves. *Anomodon attenuatus* (C/F₁₇) and *A. minor* (C₂₂) are found in similar mesohabitat and also on rocks, but usually somewhat less exposed than *Hedwigia ciliata*, growing more commonly on the trunk of hardwood trees. They are clearly pleurocarpous in branching and have costate non-hyaline leaves with often a distinct shoulder. The smaller *Anomodon rostratus* (F₁₁) is found on dry cliff faces which are usually more shaded than the microhabitat in which *Hedwigia ciliata* occurs. It has a sharp hyaline awn to the leaves, but these are again clearly costate.

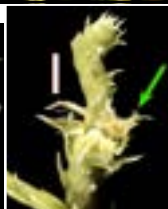
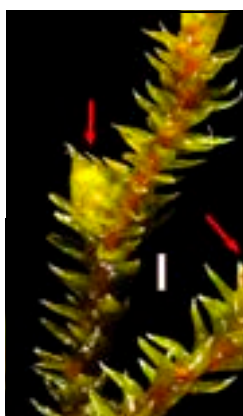
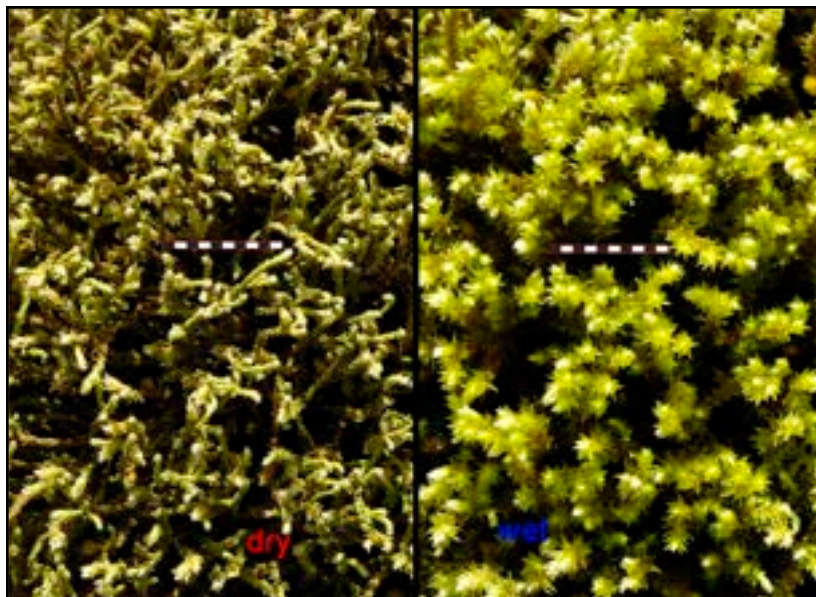
Associated Species: MesoHab: *Dicranum scoparium*, *Schistidium apocarpum* s.l., *Sanionia uncinata*; Pop: *Sanionia uncinata*, *Plagiomnium cuspidatum*, *Barbilophozia barbata*, *Schistidium apocarpum* s.l.



mat-like aspect of a dry clone on a large, exposed granite rock



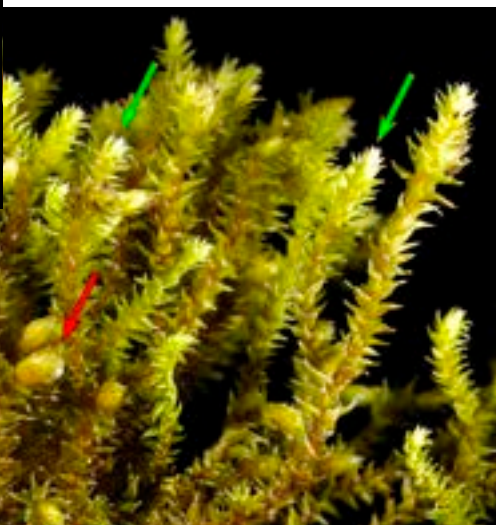
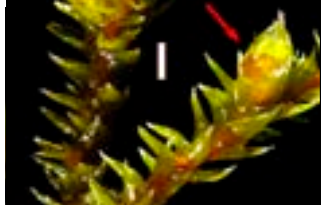
HEDWIGIA CILIATA



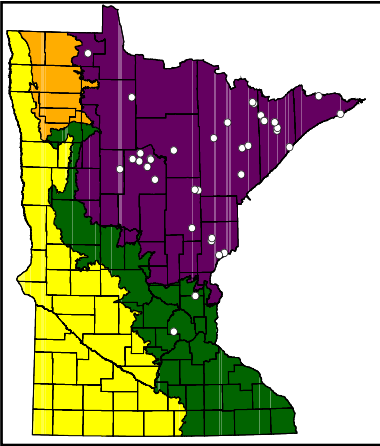
above: close-up of a small area of a patch, left when dry, right immediately after wetting

left: sessile sporophytes hidden among the perichaetial leaves; inset: when dry the cilia along the upper margins of those leaves are most obvious

below: the hyaline upper part of the leaves is most obvious at the tip of stem and branches (green arrows); sporophytes are commonly produced (red arrows)



LEUCOBRYUM GLAUCUM



plants with fleshy, slightly curved-secund leaves (above); smaller turfs and large cushions on coniferous forest floor (below)

Abundance: Frequent (F_{13}).

Habitat and field aspect: Frequent in northern wet ash and cedar/fir swamp. Occasional in southern rich conifer swamp and northern mixed woodland. Recorded from northern wet forest, poor conifer and alder swamp, and on southern wet cliff. Growing usually **on humus on forest floor as small to very large cushions (>0.5 m in diameter), very light-green to white in color**, often along trails. The surface of the cushions is smooth, and the plants (± 1 cm wide, often >10 cm tall in the large cushions) are tightly packed, hard to separate.

Aid to Identification: The **leaves are slightly curved-secund and fleshy** (with a very narrow lamina, mostly consisting of a wide costa). The older parts of the plants are a dirty white when all the chlorophyll hiding deep within the costa has been bleached.

Look-Alike Species: Only *Sphagnum* clones can have a similar cushion and color aspect, but the individual plant structure is completely different. *Paraleucobryum longifolium* (F_2) has also a grayish, bleached color (most obviously when dry) and curved to falcate-secund leaves, but usually occurs on exposed rocks. The lamina of the leaves is wider in proportion to the costa than in *Leucobryum glaucum* and thus not as fleshy in aspect, and its chlorophyllose cells are clearly lined up in longitudinal rows which are visible with the 20x handlens as dark-green lines through the surface of the costa. *Bryum argenteum* (F/O_{13}) is another silvery-white moss, but much smaller (< 1 mm wide) than *Leucobryum glaucum*. Similarly *Saelania glaucescens* (U_1) and *Pohlia wahlenbergii* (O_1) have a glaucous color or sheen, but are far smaller plants, and with narrow costae. The first is covered by a waxy cuticle, most obvious when dry, and the latter is translucent whitish-green, but with a red stem.



LEUCOBRYUM GLAUCUM

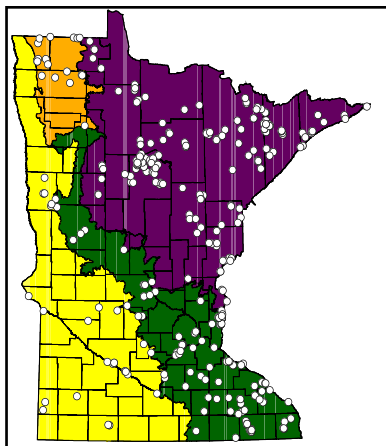
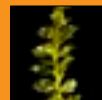
Associated Species: MesoHab: *Callicladium haldanianum*, *Tetraphis pellucida*, *Plagiomnium ellipticum*, *P. cuspidatum*; MicroHab: *Callicladium haldanianum*, *Plagiomnium cuspidatum*, *Hypnum pallescens*; Pop: *Pleurozium schreberi*, *Callicladium haldanianum*.



above top: smooth surface formed by densely packed stems, hard to separate

above and right: leaves are nearly entirely composed of a wide costa which includes the chlorophyllose cells; these are sandwiched in a single layer between multistratose layers of hyaline cells and do not form distinct lines

PLAGIOMNIUM CUSPIDATUM



Synonym: *Mnium cuspidatum*.

Abundance: Common (C₂₀).

Habitat and field aspect: Common in most mesic-hardwood classes in all regions except northwestern. Frequent, in all regions of the state, in most wet-forest and floodplain forest classes, many fire-dependent forest/woodland classes, in most forested rich peatland classes, and in all wet meadow/carr classes except basin wet meadow. Occasional on northern and southern cliff and talus, along river shore, and in northern and southern savanna and upland prairie. Recorded from northern rich fen and prairie extreme rich fen, Lake Superior rocky shore, and northern mixed cattail marsh. Growing on nearly all substrate types, but most commonly on coarse woody debris and on terrestrial soil with a high organic content. The **prostrate and stoloniferous branches with complanate leaves** are very characteristic, as well as the extreme difference between their **expanded wet and shrivelled dry state**. It also is frequently found with sporophytes, the **fertile gametophores** then **growing upright**.

Aid to Identification: Easily recognized by the **broadly and longly decurrent obovate leaves with sharp single teeth restricted to their distal part**. The costa is excurrent into a short apiculus (**cuspidate**). Both the upright male and female gametophores have a cluster of larger leaves at the top. The sporophytes **develop singly from the perichaetium** and have **large (2-3 mm) cylindrical and pendent capsules**.



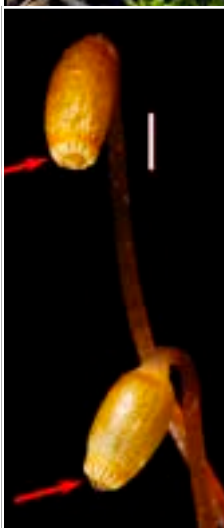
large untidy (typical) patch extending from forest floor onto old stump, with many fertile (upright) stems

Look-Alike Species: Only a single species in the large family of the Mniaceae, *Plagiomnium drummondii* (F₁₂), is very similar in structure. However, even in the field it is easily recognized by its larger overall size, more translucent and darker-green leaves (much larger cells), and sharper and longer marginal teeth. When sporophytes are present, the species is clearly polysetose. Among the other more common single-toothed Mniaceae, *P. ellipticum* (C₂₃) has more elliptical leaves, without decurrencies, and usually with poorly developed marginal teeth. *Plagiomnium ciliare* (F₃₇) also has teeth along the proximal part of the leaves, which can be broadly decurrent. Other Mniaceae, such as *Mnium* (F to U) and *Rhizomnium* (F to U) species, *Cinclidium stygium* (F₄), and *Pseudobryum cinclidioides* (F/O₁₀) have upright fertile and sterile stems, and the leaves have either no marginal teeth, or they are paired (double serrate: check with 20x handlens).

Associated Species: MesoHab: *Platygyrium repens*, *Plagiomnium ellipticum*, *Brachythecium salebrosum*, and *Callicladium haldanianum*; Microhab: *Callicladium haldanianum*, *Hypnum pallescens*, *Platygyrium repens*, and *Brachythecium acuminatum*; Pop: *Brachythecium erythrorrhizon*, *B. acuminatum*, *B. salebrosum*, *Callicladium haldanianum*, *Haplocladium microphyllum*, and *Sanionia uncinata*.



PLAGIOMNIUM CUSPIDATUM



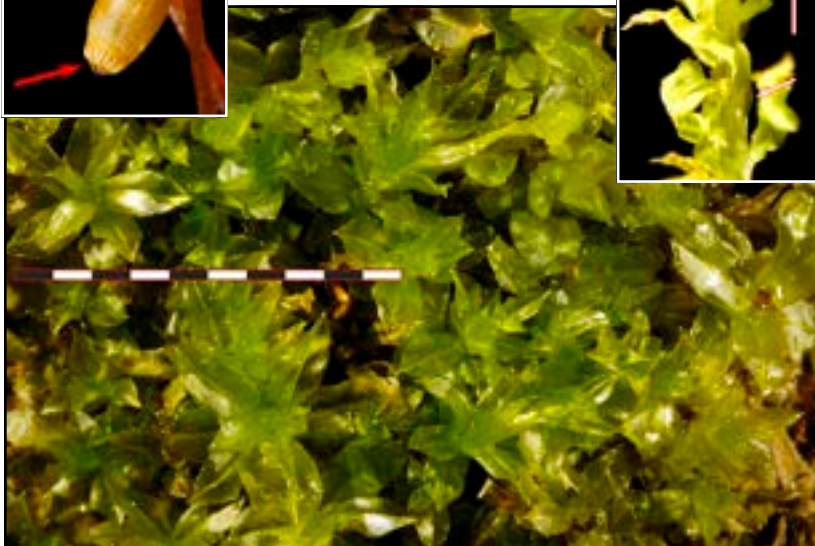
above: patch with mostly prostrate stems and complanate leaves on mesic hardwood forest floor

left: mature capsules with large pendent capsules, peristomes visible after dehiscence of opercula (red arrows)

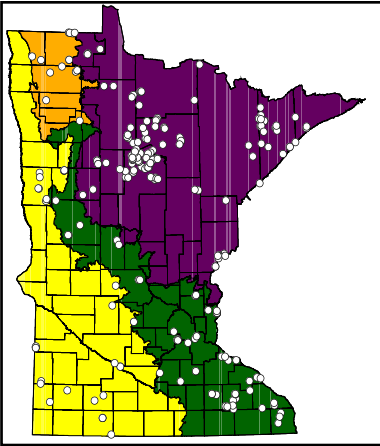
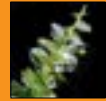
right top: fertile stem with distinctly decurrent leaf bases (white arrows) and sharply serrate upper leaf margin (blue arrow)

right below: dried stem with strongly crisped leaves, decurrent leaf bases still very obvious (white arrow)

below: patch with upright fertile stems with leaves radially inserted



PLAGIOMNIUM ELLIPTICUM



Synonym: *Mnium affine* var. *rugicum*.

Abundance: Common (C_{23}).

Habitat and field aspect: Common in wet meadow throughout the state, in forested rich peatland, and in the northern and southern very wet forest. Frequent in open northern and prairie rich and extreme rich fen (a near-obligate calcareous fen species for Minnesota). Occasional on terrace floodplain, and in northern and central mesic and fire-dependent hardwood forest and woodland. Recorded on northern wet and southern moderate cliff, on clay/mud river shore, and in northern transitional fen. The species is often hiding under thatch in meadow mesohabitat, but on forest floors with a less dominant graminoid cover it is found colonizing large depressions. Mostly it grows as small turfs above the local water table, but it can form expansive lawns, often partially submerged. The color of the clones varies from **bright green to a very dark, nearly blackish green**.

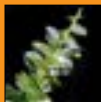
Aid to Identification: *Plagiomnium ellipticum* is charac-

terized by **medium-sized elliptic and translucent leaves** with a **narrow, non-decurrent insertion**. The **sterile stems** are typically **prostrate**, with **non- to poorly serrate leaves** in an **obvious complanate orientation**, but sexual populations (separate male and female plants) have upright stems and the leaves are larger.

Look-Alike Species: Leaves of *P. ellipticum* are up to 4 mm long, but other species in the Mniaceae might even have larger leaves. When the stems are growing prostrate, only *P. cuspidatum* (C_{26}) and *P. ciliare* (F_{13}) are similar, but differentiated by their broadly decurrent leaf bases. The marginal teeth in *P. cuspidatum* are only found in the upper part of a distinctly obovate leaf, but those of *P. ciliare* are found along the entire border, as in *P. ellipticum*. In *P. ciliare* they are, however, very long and multicellular (visible with the 20x handlens), while in *P. ellipticum* one-celled teeth dominate (and sterile shoots often have entire leaves). Other Mniaceae, such as *Mnium* (F to U) and *Rhizomnium* (F to U) species, *Cinclidium stygium* (F_4), and *Pseudobryum cinclidioides* (F/O_{10}) have upright fertile and sterile stems, and the leaves have either no marginal teeth, or they are paired (double serrate: check with 20x handlens).

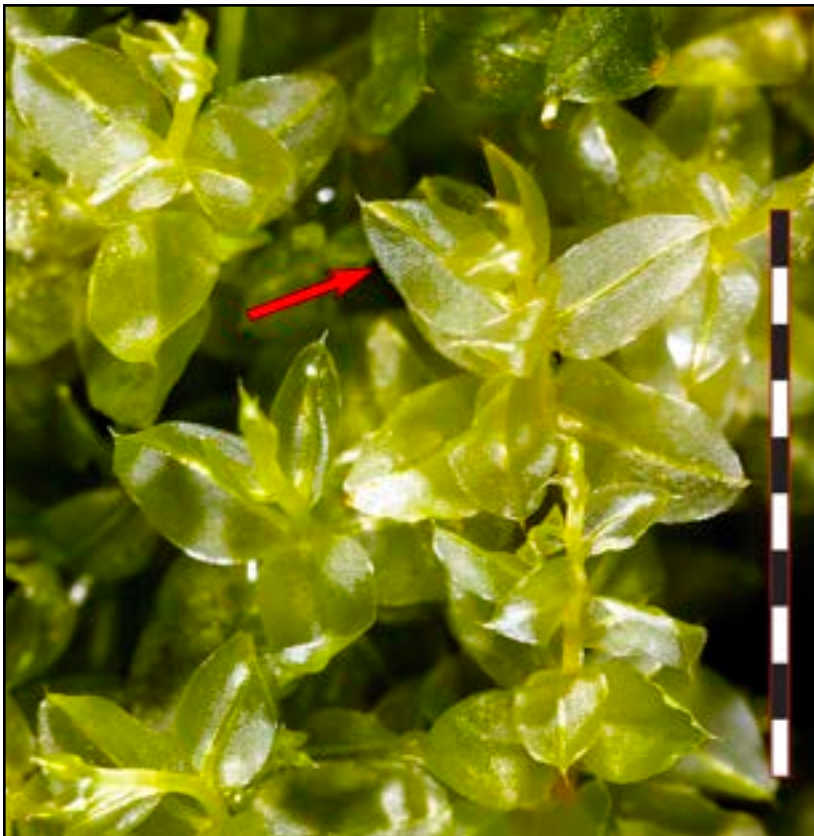


somewhat typical patch with upright growing stems (probably young either male or female stems), but more characteristic prostrate stems are shown in the inset

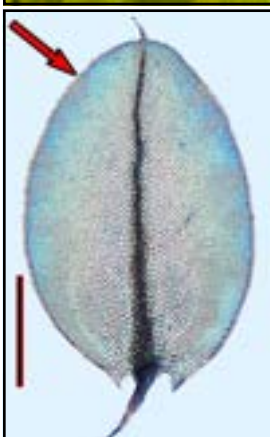


PLAGIOMNIUM ELLIPTICUM

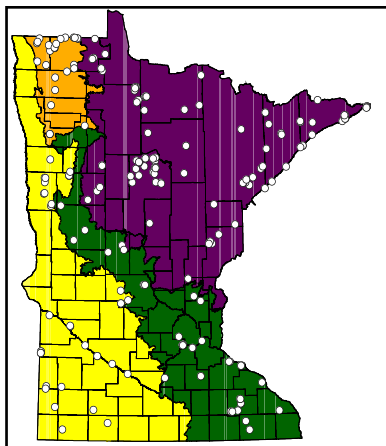
Associated Species: Mesohab: *Drepanocladus aduncus*, *Brachythecium salebrosum*, *Plagiomnium cuspidatum*, *Hypnum lindbergii*; Microhab: *Plagiomnium cuspidatum*, *Hypnum pallescens*, *Brachythecium acuminatum*; Pop: *Drepanocladus aduncus*, *Brachythecium salebrosum*, *B. rivulare*, *Hypnum lindbergii*.



elliptic leaves with small teeth along the entire border (red arrows), even sometimes nearly entire;
very narrow insertions on the stems (see white arrows)



PTYCHOSTOMUM PSEUDOTRIQUETRUM



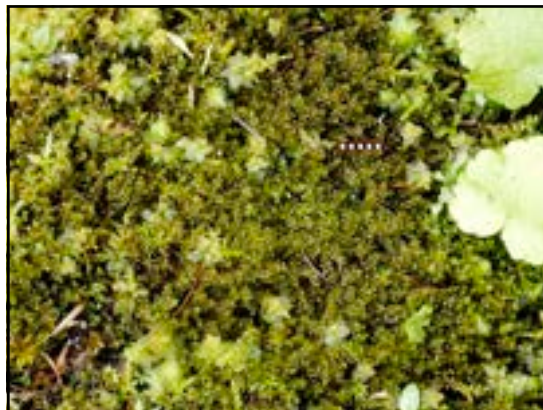
Synonym: *Bryum pseudotriquetrum*.

Abundance: Common (C₂).

Habitat and field aspect: Common in northern and prairie open rich peatland, mostly within extreme rich fen mesohabitat (a high-fidelity near obligate calcareous-fen indicator) and along rocky river and lake shore (associated with seepage). Frequent in northern, prairie, and southern wet meadow/carr, most commonly in the southern seepage meadows, and in northern forested rich peatland, mostly in patterned rich spruce swamp. Occasional in mixed cattail marsh and northern terrace floodplain forest. Recorded from northern wet forest, ash swamp, northern wet cliff and southern open talus. Occurring as separate **scattered plants among other rich-fen bryophytes**, or as **small clones of acrocarpous plants attached to woody debris**, somewhat elevated above the local water table. The **plants are quite elongated** (for a *Bryum s.l.*) and are easily distinguished by the **red stems**.

Aid to Identification: In addition, the **ovate-lanceolate leaves are strongly decurrent** along the stems, and the **internodes are usually easily observed** among them, if not covered by **dark-brown to black, sometimes protonematous, rhizoids**. The **leaves are bordered** by linear cells and narrowly revolute below, the **medial cells long-hexagonal** (20x handlens).

Look-Alike Species: Other species of *Bryum s.l.* in Minnesota are mostly shorter and somewhat comose plants, rarely found in mesohabitat frequented by *P. pseudotriquetrum*. If their stems are red, they are not as easily observed as those of *P. pseudotriquetrum*. *Pohlia nutans* (C₁₈ *P. sphagnicola*), and *Pohlia wahlenbergii* (O₂) are similar in aspect, but their leaves are narrower than those of *P.*



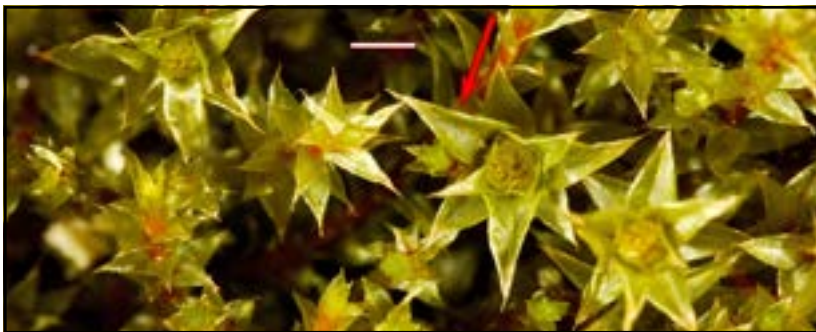
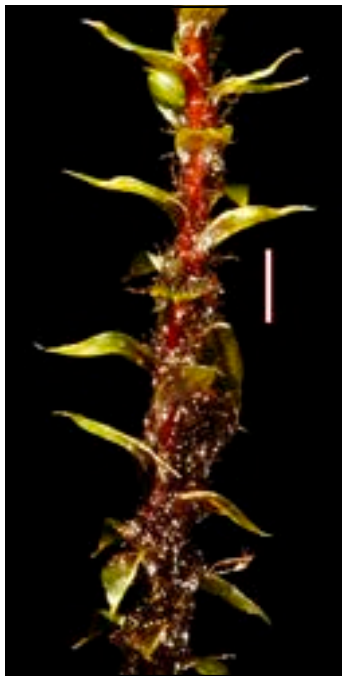
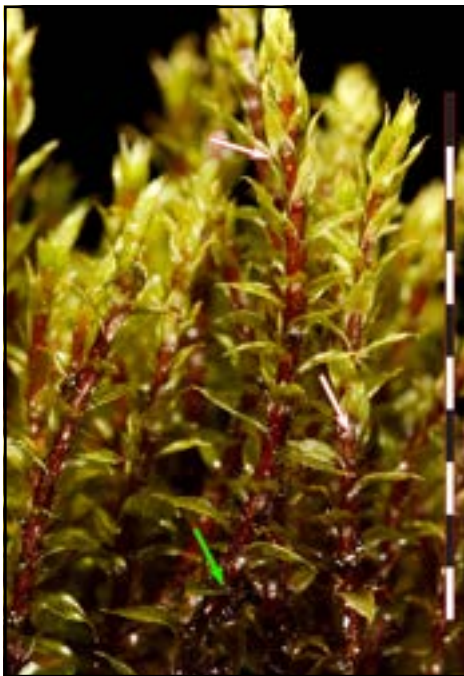
commonly found in extreme rich-fen mesohabitat among other bryophytes (top);
a rare pure population growing on wet emergent rock in a river channel (bottom)



PTYCHOSTOMUM PSEUDOTRIQUETRUM

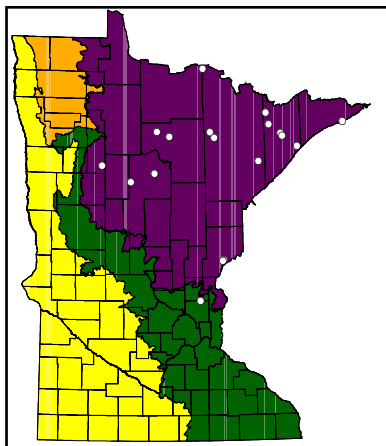
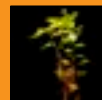
pseudotriquetrum, and not bordered. *Pohlia nutans* produces commonly sporophytes, on long, light gold-en-colored setae, while those of *P. pseudotriquetrum* are far less frequently encountered and of a coppery reddish-golden color. Red-stemmed species of the genus *Philonotis* occur more frequently in seeps and have densely packed, upright stems. The leaves are matte, unbordered, and lighter in color than those of *P. pseudotriquetrum*. The somewhat tristichous arrangements of the leaves of *P. pseudotriquetrum* plants make the species similar in aspect to the more rare and smaller, but distinctly tristichous *Catoscopium nigrum* (O₄). This species occurs mostly in extreme rich spring fens, along the edges of pools, and has a black stem. *Bryoerythrophyllum recurvirostrum* (F₁₃) is a smaller, matte, species with unbordered but recurved leaves, strongly crisped when dry. The plants are entirely reddish below, rather than just the stems.

Associated Species: MesoHab: *Drepanocladus aduncus*, *Campylium stellatum*, *Plagiomnium ellipticum*, and *Brachythecium salebrosum*; Pop: *Campylium stellatum*, *Scorpidium cossonii*, *Drepanocladus aduncus*, *Aneura pinguis*, *Brachythecium salebrosum*, and *Plagiomnium ellipticum*.



above left: the leaves are strongly decurrent along the red stems (white arrows); protonematos rhizoids (green arrow)
 above right: internodes are clearly visible, and on the older parts of the stems are covered with well-developed rhizoids
 below: the ovate-lanceolate leaves are somewhat tristichously inserted, bordered and narrowly revolute (arrow)

RHIZOMNIUM MAGNIFOLIUM



Synonym: *Mnium punctatum* var. *elatum*.

Abundance: Occasional (O_{10}).

Habitat and field aspect: Usually encountered in northern rich spruce and cedar/fir swamp. Recorded from northern and central wet-mesic hardwood forest, northern wet ash swamp and rich-fen basin. Forming large dark-green clones in shallow depressions on the swamp forest floor.

Aid to Identification: The large leaves (often to 1 cm long) are transparent, obovate-elliptic to rhomboidal, with a very narrow insertion on upright, dark-brown stems with a dense cover of rhizoids, some of those extending along the base and border of the upper leaves. The leaves also have a distinctly thickened but green entire border, and a percurrent costa.

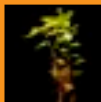
Look-Alike Species: *Rhizomnium appalachianum* (O/U_s) is of similar size, with a strong but reddish border and apiculus, and rhizoids covering the base of leaves and costae. It is not yet clear if *R. magnifolium* and *R. appalachianum* are distinct species. *Rhizomnium punctatum* (F/O_s) and *R. pseudopunctatum* (F_{10}) are similar in

structure but smaller and can only be differentiated confidently by microscopic characters. The uppermost leaves of *Rhodobryum ontariense* (F_{14}) can approach in size those of *Rhizomnium magnifolium*, but are always densely crowded because of short internodes, and are sharply serrate and obovate. Other Minnesota species in the family Mniaceae are all smaller, the leaves rarely 10 mm in length, but most species are characterized by transparent leaves with a border and a clearly narrowed insertion on the stem. *Plagiomnium* species commonly grow as sterile stems or stolons prostrate on the substrate, and the leaf border has single-serrate teeth. The true *Mnium* species are very much smaller, with double-serrate teeth, a red stem, and usually narrowly-elliptic leaves with reddish border. *Cinclidium stygium* (F_4) grows upright and has entire leaves, but both these and the stems are reddish tinted, and their costae are excurrent as small, recurved apiculi. *Cyrtomnium hymenophylloides* (U_1), much smaller than *R. magnifolium*, grows upright, but the entire leaves have a bluish tint.

Associated Species: MesoHab: *Callicladium haldanianum*, *Pleurozium schreberi*, *Tetraphis pellucida*, *Aulacomnium palustre*, *Thuidium delicatulum*; Pop: *Thuidium delicatulum*, *Sphagnum girgensohnii*, *Climacium dendroides*.



shallow depression covered by *R. magnifolium* on floor of wet coniferous forest



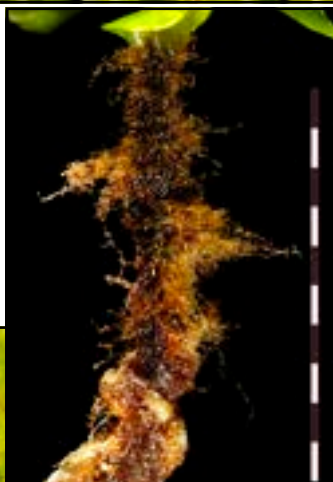
RHIZOMNIUM MAGNIFOLIUM



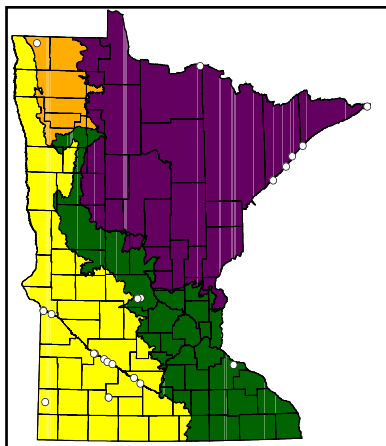
above and left: upright plants with the largest leaves near the apex, forming a crown (perigonium, arrow) in the male fertile stems, but still distinctly separated by internodes on the lower sterile stems

right: the lower parts of the stems are covered by large, branched rhizoids, sometimes forming a tomentum

below: the large leaves have a distinct green border, but there is no evidence of any teeth along it; the strong costa ends nearly at the tip, but is not excurrent as an apiculus (arrow)



SYNTRICHIA RURALIS



Synonym: *Tortula ruralis*.

Abundance: Frequent/Occasional (F/O₂).

Habitat and field aspect: On southern bedrock outcrop and along Lake Superior rocky shore. Recorded from northern mesic prairie, dry-bedrock pine (oak) woodland, and wet conifer forest. Usually in exposed microhabitat on mineral soil and rock, sometimes as extensive turfs colonizing unconsolidated sand in dune-like habitat. **When dry** the plants are recognized by the **tuft of twisted hairpoints**. **When the plants are wetted** they rapidly unwind and extend the **gracefully squarrose-recurved leaves with long and hyaline awns**.

Aid to Identification: The **upper leaves are bright green with a reddish costa which extends further into the hyaline and sharply serrate hairpoints, the lower ones a rusted red**. The **margins are narrowly revolute** for most of their length and the **leaf apices are rounded or truncate**. When dry the leaf surface is matte.

Look-Alike Species: Among species of the North American Pottiaceae, many formerly belonging to the genus *Tortula* have now been segregated as *Syntrichia*, while

species from other genera have been added to *Tortula*. However, in Minnesota only *Syntrichia ruralis* and two *Tortula* species have been recorded so far. Several other species such as *S. caninervis* (nearest record from North Dakota) and *S. norvegicum* (quite common at higher elevations in the Rockies, and found in Michigan) can be expected. The former is usually smaller than *S. ruralis*, blackish when dry, with acute leaf apices but a similar hairpoint. The latter, *S. norvegicum*, is growing in more mesic microhabitat, similar or larger in size (to 2.5 cm tall) than *S. ruralis* (to 1.5 cm tall, but exceptionally much taller), with the awns more often red in the proximal part, and the apices more acute rather than rounded. *Tortula mucronifolia* (O/U4), found on calcareous rubble and walls, is also similar to *S. ruralis*, with the upper leaves with long hyaline, but smooth, awns. However, the plants are smaller and the leaves not recurved-squarrose when wet. *Tortula obtusifolia* (O/U4) has only short-awned or apiculate leaves. Among other moss families, *Encalypta ciliata* (F/U7) (Encalyptaceae) has similarly rounded leaf apices but shorter, yellowish apiculi rather than long hyaline awns. Its sporophytes have a short peristome, while those of *Syntrichia* and *Tortula* are tall, consisting of long teeth spirally wound together. *Schistidium apocarpum* (F₁₂, Grimmiaceae) has sessile sporophytes with a peristome with short, red teeth, and the hairpoints are variable in length, sometimes nearly absent. *Grimmia*



moist patch at the base of a sandy cliff, the wet, expanded plants with distinct stellate aspect



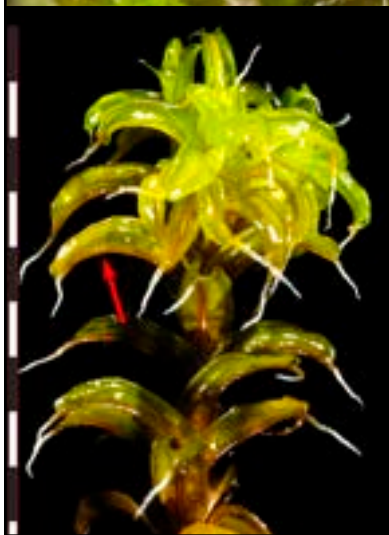
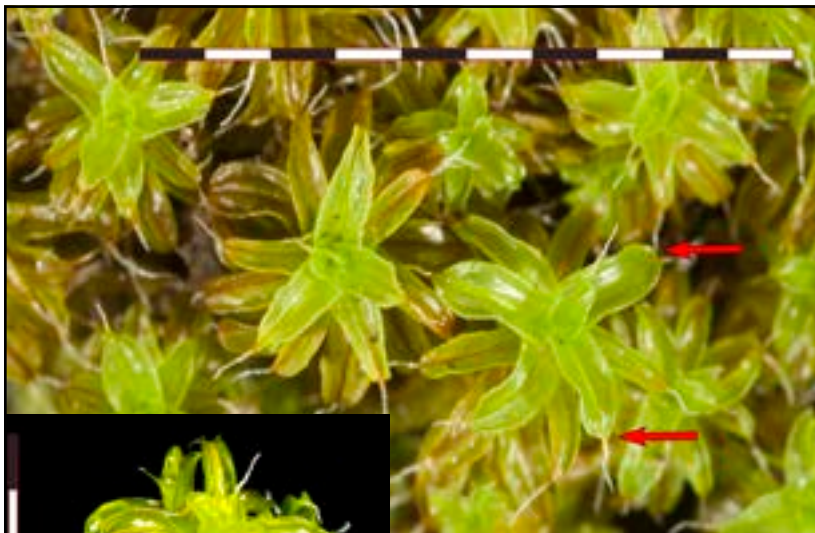
SYNTRICHIA RURALIS

laevigata (F/U6, Grimmiaceae) has long hyaline hairpoints, but the base of these awns is decurrent with the acuminate leaf apex, and the costae are much less pronounced than those of the Pottiaceous mosses with hyaline hairpoints.

Associated Species: MesoHab: *Ceratodon purpureus*, *Hedwigia ciliata*, *Abietinella abietina*; Pop: *Ceratodon purpureus*, *Bryum argenteum*, *Abietinella abietina*.



dry (left) and wet (right) close-up of the same small patch

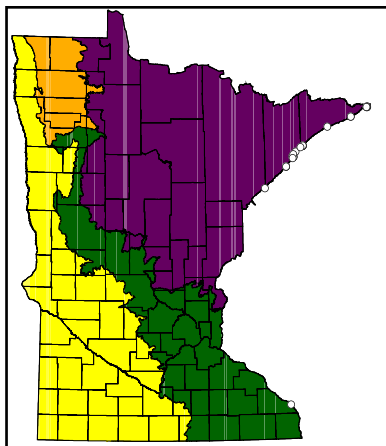


above: most leaf laminae are rounded to truncate at the apex, with the excurrent reddish costa forming the hyaline hairpoint, some still reddish at the base (but not as common as in *S. norvegica*)

far left: the leaves are strongly squarrose-recurved when wet

left: flexuose and twisted when dry, the hairpoints often twist together

TORTELLA TORTUOSA



Abundance: Frequent (F₃).

Habitat and field aspect: Along Lake Superior wet rocky shore and occasional on northern wet mafic cliff. Recorded from northern mesic cliff, wet conifer forest, and rocky river shore, and from southern prairie. Usually encountered as small turfs in exposed microhabitat.

Aid to Identification: The leaves are strongly crisped and twisted when dry, flexuose when wet. Most characteristic is the pronounced glossy and yellowish abaxial surface of the strong costae. When wet the leaves show a hyaline V-shaped proximal part to the lamina which might extend quite high up along the margins and is abruptly delineated from the matte and green distal laminal cells.

Look-Alike Species: All *Tortella* species are characterized by the shiny back of the costae and the hyaline basal leaf cells extending in a V-shaped area up along the margins, a combination of character states not seen in other

Pottiaceae, where many species are similar matting small acrocarps with narrowly lanceolate leaves, often contorted or twisted when dry. *Tortella humilis* (U₂) and *T. inclinata* (R₁) are smaller plants (leaves 2-4 mm long, rather than often > 5 mm as in *T. tortuosa* and *T. fragilis*), and, in addition, *T. inclinata* has cucullate leaf apices. *Tortella fragilis* has a very stiff look, both wet and dry, and with erect, somewhat curved-second leaves (reminiscent of the medium-sized *Dicranum viride*, which is, however, darker green) and with nearly all their tips broken off, except for the youngest. *Tortella tortuosa* var. *fragilifolia* has a potential record from Roseau County, still to be confirmed. This variety is differentiated by its fragile leaf tips, but is still distinct in the field from *Tortella fragilis* (O₃) by more curled leaves when dry. *Trichostomum tenuirostre* (O₇), another similarly sized Pottiaceae with narrowly lanceolate leaves which are contorted when dry, has less-well differentiated hyaline basal cells, not forming a clear border extending up along the margins of the leaf as in *T. tortuosa* and *T. fragilis*.

light green, with flexuose
leaves when wet;
sporophytes on tall setae,
capsules erect





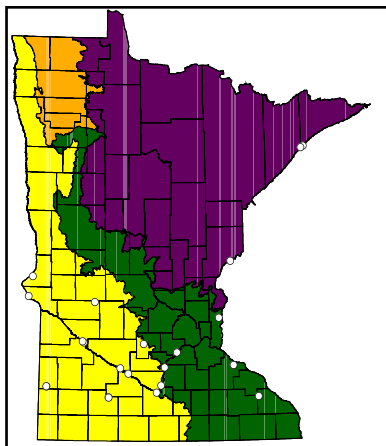
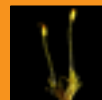
TORTELLA TORTUOSA

Associated Species: MesoHab: *Schistidium apocarpum* s.l., *Ptychostomum pseudotriquetrum*, *Campyliadelphus chrysophyllus*, *Hygrohypnum luridum*; Pop: *Schistidium apocarpum* s.l., *Hygrohypnum luridum*, *Mnium thomsonii*, *Campyliadelphus chrysophyllus*.



when dry the leaves are strongly contorted and twisted spirally together; the leaf margins are somewhat wavy; the costae are stout and their prominent back (abaxial surface) is highly glossy, contrasting with the matte aspect of the upper lamina

WEISSIA CONTROVERSA



Abundance: Frequent/Occasional (F/O₂).

Habitat and field aspect: Confirmed on southern bed-rock outcrop and in dry prairie. Recorded from Lake Superior and river rocky shore, and clay/mud river shore, and from southern mesic prairie and on open talus. Probably quite overlooked or confused with similar Pottiaceous species: the plants are small, and the species forms small unobtrusive patches of scattered plants or open turfs along rock crevices and on disturbed (ruderal) mineral surfaces.

Aid to Identification: The plants are only a few mm tall. Typically, when dry the leaves are incurved, twisted, and strongly involute. Wetted they become quickly far more obvious, and the bright green but matte leaves are oblong with an acute or mucronate apex. Most characteristic are their erect-incurved, inflexed, to strongly involute margins (curved or rolled inwards on the adaxial side, rather than the much more common revolute state, where they are rolled outwards on the abaxial side). Most diagnostic characters of the gametophores, however, are highly technical and their states often very variable within related species, or both. The setae are

yellowish, with erect capsules with long-rostrate operculum, plicate with age; the peristome teeth are often much reduced.

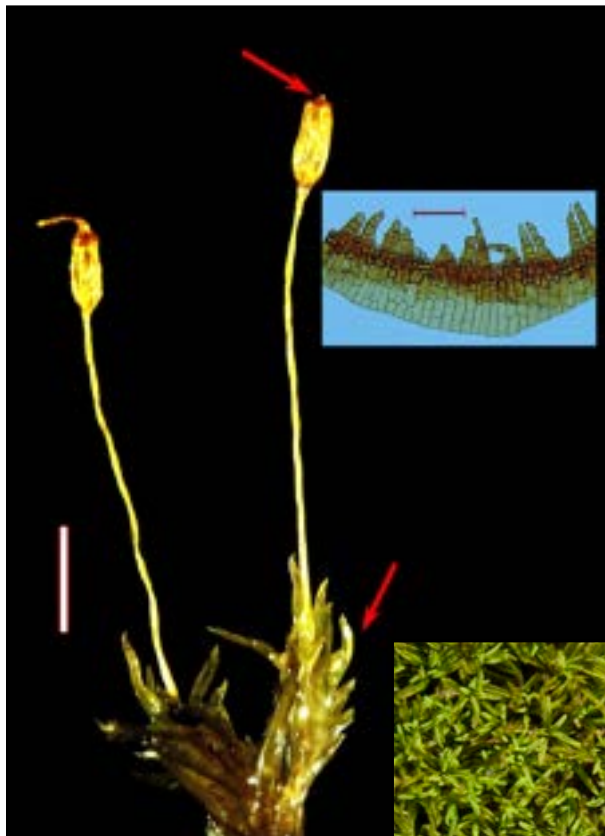
Look-Alike Species: In similar habitat the most common species encountered would be *Ceratodon purpureus* (C/F₂₂). It is quite a bit larger than *W. controversa*, and its leaves are more lanceolate and with a distinct revolute border nearly reaching the apex. Small Pottiaceae species with a similar field aspect occurring in Minnesota, such as *Didymodon rigidulus* (O/U₄) and *Barbula unguiculata* (O/U₄), have also distinct revolute margins. The leaves of *Gymnostomum aeruginosum* (F₃) are plane, but this hygrophytic species occurs usually as large dense turfs in seepage on rocks. *Hymenostylium recurvirostrum* (O₂), in similar habitat, has often a recurved leaf margin, at least on one side. Both previous species also have eperistomate capsules; in *W. controversa* a rudimentary peristome might be present. *Trichostomum tenuirostre* (O₂) has long-lanceolate leaves with a larger hyaline base and plane leaf margins. Other *Weissia* species, and possibly hybrids, even intergeneric hybrids with other Pottiaceae, might occur in the state.





WEISSIA CONTROVERSA

Associated Species: MesoHab: *Bryum argenteum*, *Campyliadelphus chrysophyllus*, *Schistidium apocarpum* s.l.; Pop: *Gemmabryum caespiticium*.



very small plants with acute to mucronate leaves with nearly plane, but most characteristically incurved to tightly inrolled leaf margins; the species is highly polymorphic and a number of related species or even hybrids might exist in the state which are not yet well studied; when sporophytes are present, the capsules might have a peristome (inset), which would differentiate plane-leaved specimens from *Gymnostomum aeruginosum*



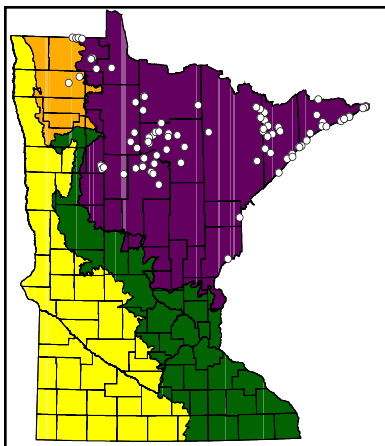
Other Acrocarps

June 2016



FEATHER MOSSES

HYLOCOMIUM SPLENDENS



Abundance: Common (C_{12}).

Habitat and field aspect: Common along Lake Superior dry and wet rocky shore. In forested rich peatland frequent in northern rich spruce swamp, less so in rich tamarack and cedar/fir swamp, and recorded from northern alder swamp and northwestern rich conifer swamp. Occasional in northern dry to mesic pine and mixed fire-dependent woodland, and in northern wet conifer forest. Recorded on northern moist and wet cliff, in mesic hardwood forest, in rich and extreme rich fen, and in northern spruce bog and poor conifer swamp. Usually the large wefts on the forest floor are easily to spot. Rarely smaller clones are found on coarse woody debris and stumps, or on large rocks among other bryophytes. No other large pleurocarp has the **distinct annual increments that form the characteristic stair-step fronds**.

Aid to Identification: In addition to its **weft growth form** and the **sympodial branching**, *Hylocomium splendens* is diagnostically identified by the combination of **tri-pinnately branched fronds**, abundant **stem- and branch paraphyllia**, and **large appressed primary-branch leaves with often a long, double costa**.

Look-Alike Species: The closest related species in Minnesota is *Hylocomiastrum pyrenaicum* (O/U_4). It rarely forms frondose tiers, the large primary-branch leaves are spreading, and their costae usually single. The other large weft-forming pleurocarps *Pleurozium schreberi* (C_{19}) and *Rhytidiadelphus triquetrus* (C_{17}) have no stem and branch paraphyllia. The *Thuidium* species *T. delicatulum* (C_{21}) and *T. recognitum* (C_{20}) are distinctly matte (because of shorter and more highly papillose cells), and with less obvious annual stair-step fronds. They are however, also clearly tri-pinnately branched.

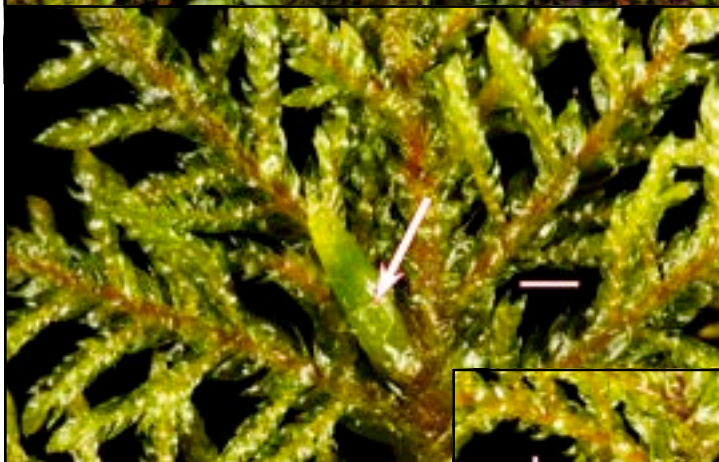
Associated Species: Mesohab: *Pleurozium schreberi*, *Ptilidium pulcherrimum*, *Sanionia uncinata*, *Tetraphis pellucida*, *Callicladium haldanianum*, *Dicranum flagellare*, *Dicranum polysetum*; Microhab: *Callicladium haldanianum*, *Plagiommium cuspidatum*; Pop: *Pleurozium schreberi*, *Barbilophozia barbata*.



large weft on the forest floor of a extreme rich tamarack swamp; note some large-leaved plants of the irregularly branched *Rhytidiadelphus triquetrus* among the frondose fronds of the *H. splendens* on the left



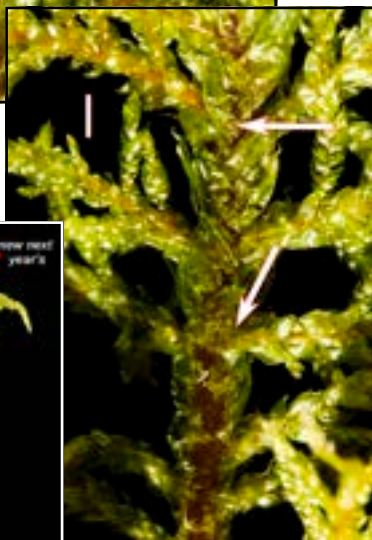
HYLOCOMIUM SPLENDENS



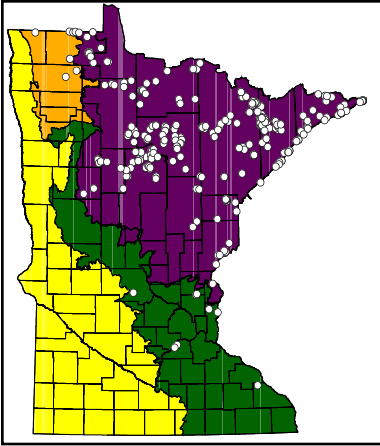
top and middle: moist the tri-pinnate branching appears orange to red

right: stem covered by paraphyllia

middle and below: sympodial branching forming the stair-steps: early in the growing season the new fronds start as fast growing and large, as yet unbranched side stems, easily recognized



PLEUROZIUM SCHREBERI



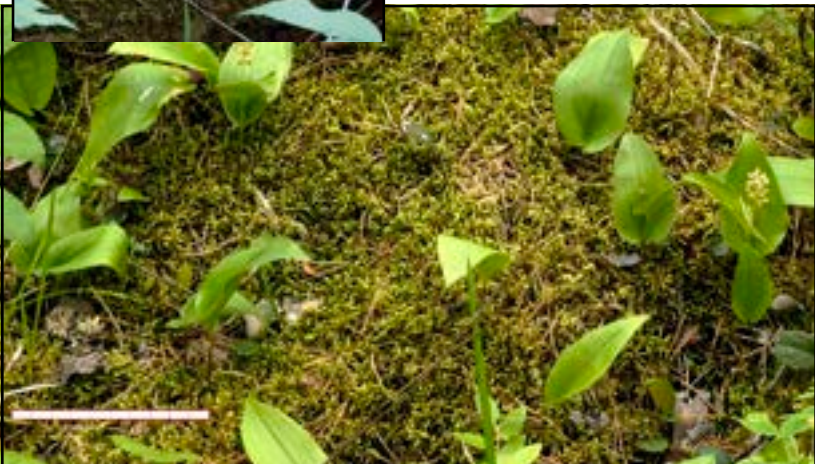
Abundance: Common (C_{19}).

Habitat and field aspect: Abundant in forested rich peatland, acid peatland, and fire-dependent forest and woodland: in forested rich peatland associated with black spruce and tamarack, less so with cedar/fir and alder; in northern acid peatland nearly constant in spruce bog and poor conifer swamp, but far less frequent in open bog, poor fen, or transitional fen; in northern and central regions in both dry to mesic pine woodland and mixed forest. Occasional along Lake Superior rocky shore, in northern wet forest, usually associated with conifers rather than alder and ash, and in mesic boreal and mixed hardwood forest with some cedar. Encountered in northern open rich peatland, from shrub shore fen to extreme rich fen. Recorded from moist and wet cliff. Nearly always underneath conifer-tree canopy on organic duff, or very nearby. Often covering large lawns, also found as small clones among other bryophytes on coarse woody debris, tree trunks, or rocks. Less frequently on peat or on fine clastic material. The large wefts are **highly glossy in sunlight and when dry**.

Aid to Identification: Wet the **irregular uni-pinnate** plant is recognized by the **red color of its main branch ('stem')**. When dry the **highly glossy leaves** obscure the color. All **branches without paraphyllia**. The leaves are **concave, with a blunt but short-apiculate and recurved apex**.

Look-Alike Species: No other weft forming species has the combination of uni-pinnate branching, high gloss, red branches, and short-apiculate leaves. Other feather mosses are either more distinctly uni-pinnate with circinate leaves (*Ptilium crista-castrensis*, C_{14}), tri-pinnate and with paraphyllia (*Hylocomium splendens*, C_{12}), and the *Thuidium* species (C_{20-21}), or have much larger triangular plicate leaves (*Rhytidiadelphus triquetrus*, C_{17}).

Associated Species: Mesohab: *Callicladium haldanianum*, *Aulacomnium palustre*, *Ptilidium pulcherrimum*, *Sphagnum angustifolium*, *S. magellanicum*, *Dicranum polysetum*, *Polytrichum strictum*, *Dicranum flagellare*; Microhab: *C. haldanianum*, *Plagiomnium cuspidatum*, *Hypnum pallescens*, *Platygyrium repens*; Pop: *Dicranum polysetum*.



below: glossy lawn on the dry forest floor of a jack-pine forest,
above left: but also colonizing coarse woody debris along a trail in a hardwood forest

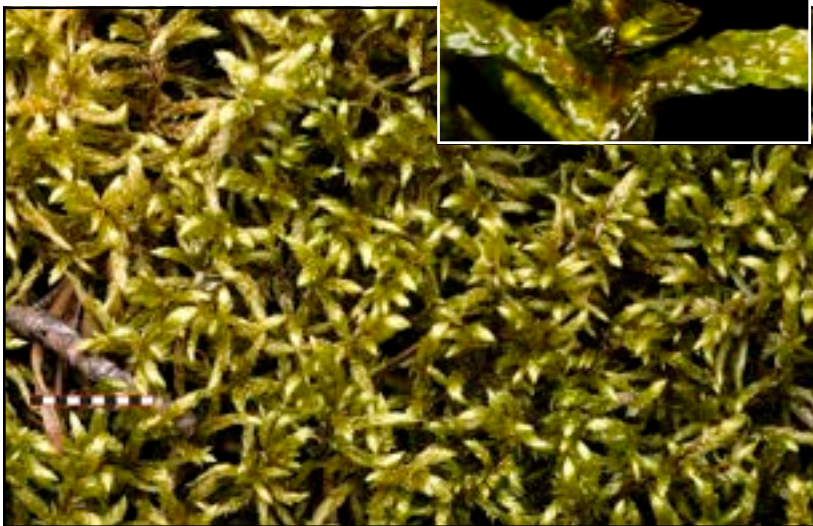
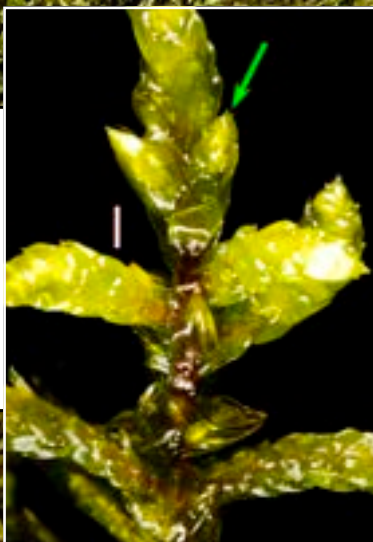


PLEUROZIUM SCHREBERI

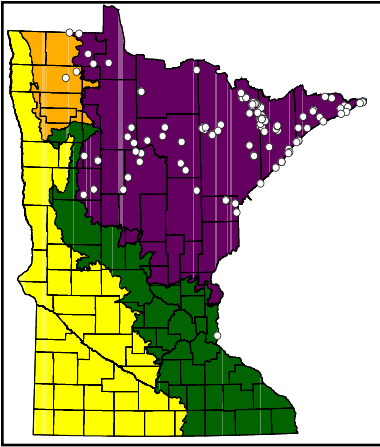


above: the wefts are easily removed from the substrate, as they are only slightly attached on the duff under the conifer canopy, with the tree needles constantly sifting through the loosely packed plants

below and right: the plants are more or less pinnately branched (when wet the red main, upright and naked (without paraphyllia), branch ('stem') is clearly visible through the concave and apiculate leaves (right), but when dry the high gloss of the leaves hides the color (below)



PTILIUM CRISTA-CASTRENSIS



Abundance: Common (C₁₄).

Habitat and field aspect: Common in northern fire-dependent woodland and mixed forest, and recorded from central dry pine woodland. Occasional in northern wet conifer forest and in rich spruce and cedar/fir swamp, and recorded from northern tamarack, alder, ash, and northwestern rich conifer swamp. Found on Lake Superior rocky shore, and in northern spruce bog and poor conifer swamp. Recorded from mesic hardwood forest with cedar, and from mesic cliff. Rarely is this species found in large expansive populations, more commonly as small patches on the forest floor among other weft forming and tall-turf bryophytes. It occurs in somewhat more mesic microhabitat than several of the other large feather mosses, except for *Hylocomium splendens* (C₁₂). It frequently colonizes coarse woody debris and organic duff and soil. It is rarely found on rock, sand, and exposed peat. The **near perfect feather-shape of the individual plants** is unmistakable. The **main branches ('stems') are often crowded and are standing upright**.

Aid to Identification: Strictly and **regularly uni-pinnately branched**. The **ecostate leaves are strongly falcate** to circinate, and decurrent (turned downward) along the main branch and side branches. They are also **distinctly plicate**, which makes it difficult to confirm that there are ecostate.

Look-Alike Species: The main branch is green to slightly brown-orange, not distinctly red, as in the other uni-pinnately feather moss *Pleurozium schreberi* (C₁₉). The latter is far less uniformly feather-shaped and has ovate, short-apiculate leaves. *Ptilium crista-castrensis* is differentiated from closely related large and sometimes regularly uni-pinnate *Hypnum* species (C to U) by its upright habit and strongly plicate leaves: those *Hypnum* species rather form mats than wefts. *Sanionia uncinata* (C₁₂) appears quite similar to *P. crista-castrensis* when only poor material of the latter is available, or if it is found as single stems among other bryophytes. The circinate *Sanionia uncinata* leaves are distinctly costate and usually far less plicate than those of *P. crista-castrensis*, and the plants are less perfectly feather-shaped; the apices of its young branch leaves are also sharply serrate, visible with a 20x handlens in the field.

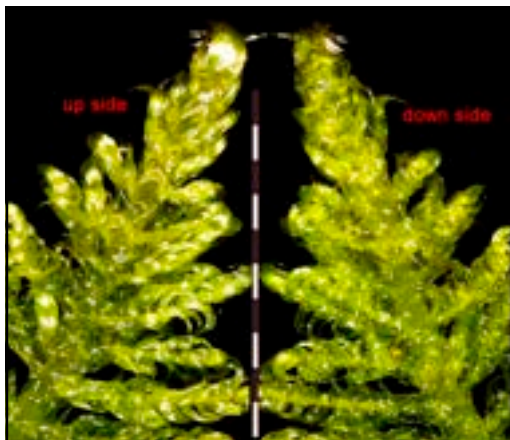
Associated Species: Mesohab: *Pleurozium schreberi*, *Ptilidium pulcherrimum*, *Callicladium haldanianum*, *Dicranum polysetum*, *Sanionia uncinata*, *Dicranum flagellare*; Microhab: *Callicladium haldanianum*, *Plagiomnium cuspidatum*, *Hypnum pallescens*, *Platygyrium repens*; Pop: *Pleurozium schreberi*.



upright feathery of *Ptilium crista-castrensis* on forest-floor duff in a jack-pine woodland; note the somewhat similar looking plants of *Pleurozium schreberi* in this mixed patch, distinguished by their red main branch (at arrow)

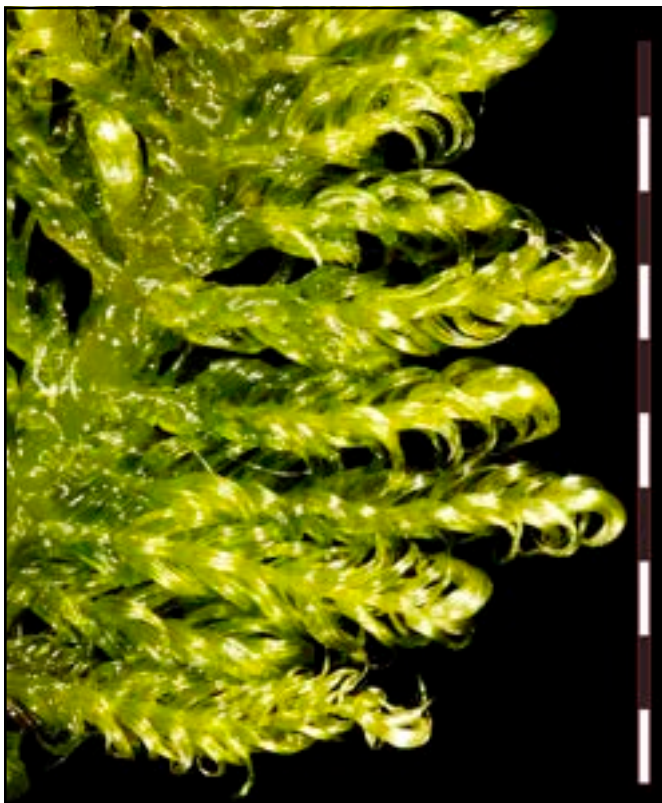


PTILIUM CRISTA-CASTRENSIS



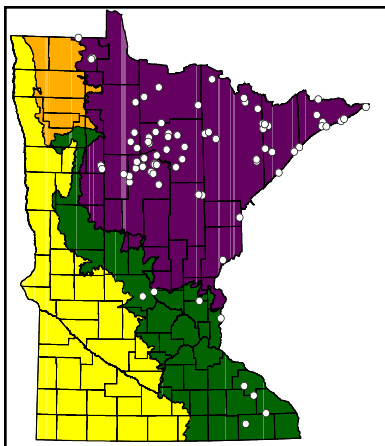
above: the highly falcate to circinate leaves are curved strongly to one side; the smooth linear cell type makes the leaves and plants highly glossy when wet

left: this dry plant has still preserved somewhat the regular aspect of a feather: two annual increments above each other and one side main branch to the right are visible



the leaves are plicate and ecostate (the latter feature only easily to observe using a compound microscope because of the plicae)

RHYTIDADELPHUS TRIQUETRUS



Abundance: Common (C_{17}).

Habitat and field aspect: Common in northern rich swamp associated with tamarack and cedar/fir, less frequently with black spruce and alder. Frequent in southern rich conifer swamp, and in northern wet and very wet ash and conifer forest. Occasional in northern dry to mesic pine and mixed fire-dependent woodland and forest. Recorded from northern wet cliff, and southern open talus and moderate cliff. Also in northern and central mesic hardwood forest with some cedar or conifer, along Lake Superior rocky shore, and in northern rich fen. This large stemmed species often forms expansive lawns in drier microhabitat in dense shade, on forest-floor duff and humus. Frequently separate stems or small clones are found among other weft-forming feather mosses, or on coarse woody debris. The **stems are irregularly or sub-pinnately branched and stiff**, sometimes earning the species the sobriquet of 'pipe-cleaner moss'.

Aid to Identification: The **large triangular and serrate leaves are plicate**. The **wefts are loose** in structure, and individual plants can be easily separated. There are **no paraphyllia** along the stem and branches.

Look-Alike Species: Compared with any of the other forest-floor species, its leaves are huge (up to 5 mm long and 2.5 mm wide). They are serrate and acute to acuminate, rather than obtuse as in the closely related *Pleurozium schreberi* (C_{10}). The branching is irregular, rarely somewhat pinnate. Annual increments are less obvious than those of the paraphyllose and tri-pinnate *Hylocomium splendens* (C_{12}) and *Thuidium* (C_{20-21}) species. The related *Rhytidium rugosum* (O_2) is a far more xerophytic plant, often growing on sunny rock ledges. Its curved-falcate leaves are ovate-lanceolate, rugose (both transversely as well as longitudinally wrinkled) rather than plicate, and the plants are more pinnately branched.

Associated Species: Mesohab: *Thuidium delicatulum*, *Pleurozium schreberi*, *Tetraphis pellucida*, *Thuidium recognitum*, *Dicranum flagellare*, *Callicladium haldanianum*, *Plagiomnium ellipticum*; Microhab: *Callicladium haldanianum*, *Hypnum pallescens*, *Plagiomnium cuspidatum*; Pop: *Thuidium delicatulum*.



large weft formed by stiff, irregularly branched upright stems on forest-floor duff along a trail in fire-dependent conifer forest



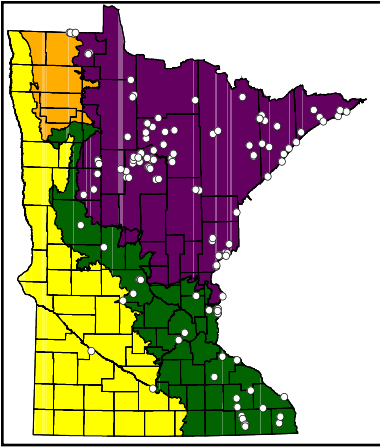
RHYTIDIADELPHUS TRIQUETRUS

right: large triangular leaves, distinctly plicate and somewhat rugose; the costa is double and long, hidden among the plicae

below: stem without paraphyllia, irregularly to sub-pinnately branched



THUIDIUM DELICATULUM



Abundance: Common (C_{21}).

Habitat and field aspect: Common in northern and southern forested rich peatland, most frequently associated with cedar, and in northern and southern wet forest with ash. Frequent on northern and southern terrace floodplain, in the south mainly on open talus, but also on mesic, moderate, and algalic cliff, and in the north on wet cliff. Occasional in northern and central dry to mesic fire-dependent mixed forest and woodland, and in dry to wet-mesic hardwood forest with a conifer component. Recorded from northern open rich fen and from prairie extreme rich fen, from river shore, and from northern poor conifer swamp and transitional fen. Easiest to recognize when the species forms small hummocks or expansive lawns on the forest floor, usually in drier microhabitats on duff. It occurs more commonly, however, as separate plants mixed with other bryophytes, or as small clones on coarse woody debris, on rocks, litter, and humus, rarely on mineral soil. When dry the patches are definitely **matte in aspect**, and the branches form **densely interwoven, compact, and usually smooth-surfaced but domed wefts**.

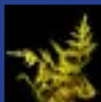
Aid to Identification: The plants are **tri-pinnately branched** and the branches are **covered by paraphyllia**. The **plants are matte** when dry because of the short and densely papillose leaf cells. **Annual increments are obvious**.

Look-Alike Species: *Thuidium delicatulum* is differentiated from *Pleurozium schreberi* (C_{19}), *Ptilium crista-castrensis* (C_{14}), and *Rhytidiadelphus triquetrus* (C_{17}) by its tri-pinnate branching; from the tri-pinnate *Hypnum splendens* by its annual increments without the clear stair-step shaped fronds (but sometimes a close look is needed!). It is nearly impossible to recognize *Thuidium delicatulum* from *T. recognitum* (C_{20}) in the field. A close study of the main-branch ('stem') leaves with the 20x handlens might make the distinction possible: *T. delicatulum* has 'stem' leaves with narrowly acuminate, and mostly straight or wavy apices; those of *T. recognitum* are stoutly recurved (a modification of *T. delicatulum* with a long uniseriate apex is sometimes segregated as a variety or subspecies (*radicans*), or even as a species, named *T. philbertii*, O.). Other characters need to be studied with the microscope, the most reliable one the position of the papillae on the paraphyllia. The related Minnesota species *Cyrto-hypnum minutulum* (O.) and *C. pygmaeum* (R.) are a lot smaller, and only 1-2 pinnate. *Abietinella abietina* (F.) is as large a weft forming species as *T. delicatulum* and *T. recognitum*, but strictly uni-pinnate and growing in exposed, xerophytic microhabitats.

Associated Species: Mesohab: *Plagiomnium cuspidatum*, *P. ellipticum*, *Platygyrium repens*, *Callicladium haldanianum*, *Climacium dendroides*, *Hypnum lindbergii*; Microhab: *Callicladium haldanianum*, *P. cuspidatum*, *Hypnum pallenscens*, *Platygyrium repens*; Pop: *Plagiomnium ellipticum*, *Climacium dendroides*.



characteristic domed weft on a hardwood forest floor

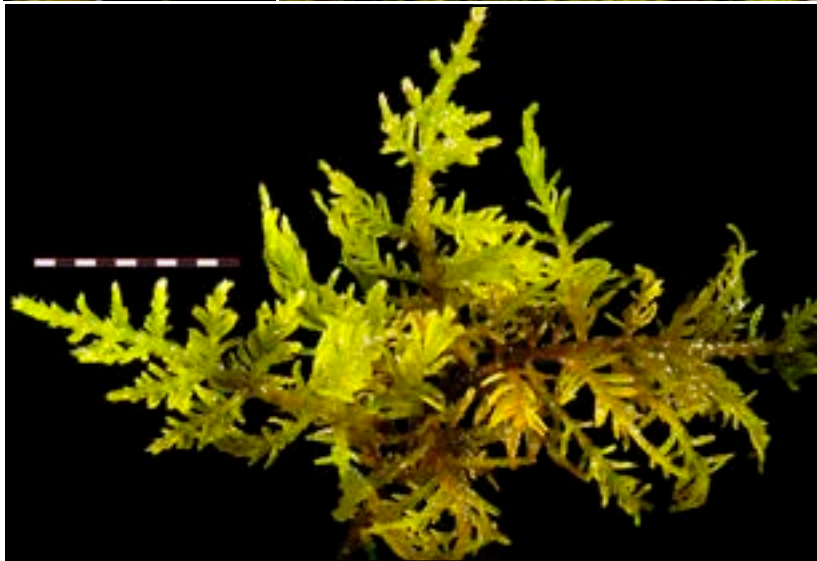


THUIDIUM DELICATULUM

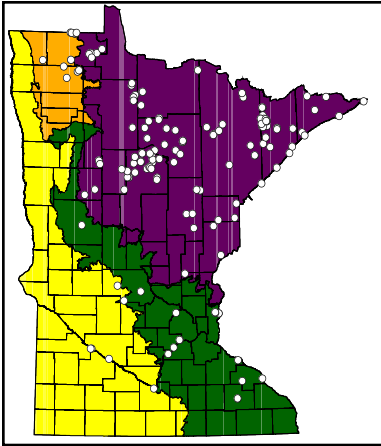
right: the relatively smooth surface of the weft is formed by the interwoven last-year's increments, without clear stair-step fronds (the surface of *T. recognitum* wefts is often even smoother, and the latter species forms usually flatter wefts in slightly drier microhabitats)

middle: the branching is clearly tri-pinnate and the main branch covered with numerous paraphyllia (blue arrow)

bottom: the yearly increments are obvious, but do not originate by forming the initially unbranched arching main branch as in *Hylocomium splendens*, and the plants are less glossy, certainly when dry



THUIDIUM RECOGNITUM



Abundance: Common (C_{20}).

Habitat and field aspect: Common in the forested rich peatland types of northwestern rich conifer swamp and northern cedar/fir, alder, spruce, and tamarack swamp. Frequent in wet forest such as northern alder carr and wet ash swamp. Occasional in northern and central mixed and pine woodland, northern mesic hardwood, northern rich fen, and northern and southern wet meadow/carr. Recorded from southern mesic cliff, clay/mud river shore, northern terrace forest, and northern poor conifer swamp. Forms **flat, mat-like populations** in dry microhabitat on organic litter and humus, but is **still easily removed from the substrate**, or it grows as separate stems among other weft-forming bryophytes. Found in over a quarter of the same ecotopes as its congener *T. delicatulum* (C_{21}), sometimes even mixed in the same patch. Both species are very similar, but pure populations of *T. recognitum* tend to have a **flatter and somewhat drier field aspect**. The plants are **very matte**,

obvious when dry.

Aid to Identification and Look-Alike Species: See the discussion under *T. delicatulum*. Both species are distinctly **three-pinnately branched and the stems covered with paraphyllia**. Only the structure of these paraphyllia, when studied under the compound microscope, allows for confident differentiation between the two species, but using the 20x handlens, it might be possible to use stem-leaf characters. Sometimes the stems are not completely tri-pinnately branched (see photos below) and then a depauperate specimen might appear similar to *Haplocladium microphyllum* (C_{24}). This species is distinctly mat- rather than weft-forming, however.

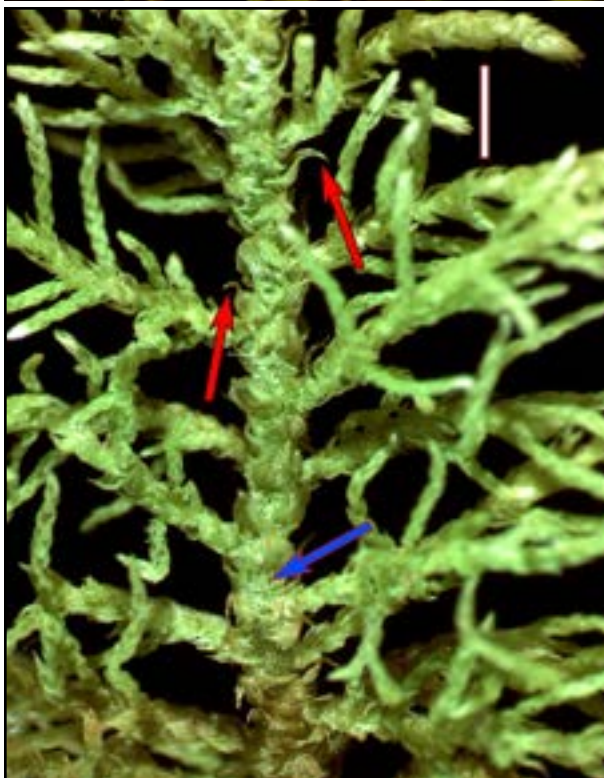
Associated Species: Mesohab: *Plagiomnium ellipticum*, *Callicladium haldanianum*, *Climacium dendroides*, *Hypnum lindbergii*; Microhab: *Callicladium haldanianum*, *Platygyrium repens*, *Plagiomnium cuspidatum*, *Hypnum pallescens*; Pop: *Pleurozium schreberi*, *Climacium dendroides*, *Brachythecium erythrorrhizon*, *Plagiomnium ellipticum*.



flat extensive weft on mixed hardwood forest floor



THUIDIUM RECOGNITUM



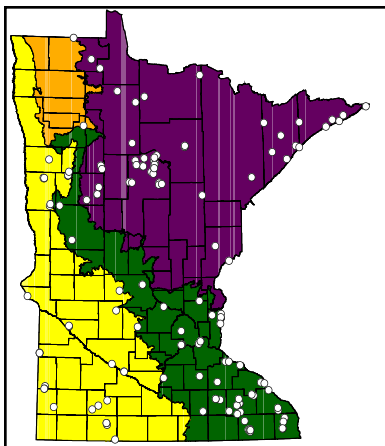
above: imperfectly tri-pinnately
branches shoots

left: with the 20x handlens it is
possible to see the paraphyllia
(blue arrow) among the larger
stem leaves; these leaves have
a stout and often recurved
apex (red arrows), but this is
not an easily seen character
state to rely on completely in
the field to differentiate the
species from *T. delicatulum*



COSTATE WETLAND PLEUROCARPS

BRACHYTHECIUM RIVULARE



Abundance: Common (C_{21}).

Habitat and field aspect: Common along river shore. Frequent in northern, southern, and prairie wet meadow, and open-rich and extreme-rich patterned and basin peatland, often along spring pools. An near-obligate calcareous fen indicator in Minnesota. Occasional in northern and southern forested rich peatland, mostly associated with alder and tamarack, less so with black spruce. Recorded from northern wet forest, usually associated with black ash, from southern wet-mesic hardwood forest, and along lake shore. A distinct pendent modification is found in seepage on northern wet and southern wet and moderate cliff, and on talus. Large populations are often somewhat **subdendroidally branched, of a light-green color, usually very glossy.**

Aid to Identification: The **costate and smooth stem leaves** on typical plants are ovate-lanceolate, with a **distinct apiculus**. The capsule is elevated on a **entirely papillose seta**, the papillae visible with a 20x handlens.

Look-Alike Species: Most specimens of *Brachythecium* s.l. (including *Sciuro-hypnum*) without mature sporophytes can only be identified tentatively. In wetlands *B. salebrosum* (C_{25}) also occurs commonly, but can be differentiated by plicate leaves. *Brachythecium acuminatum* (C_{26}) and *B. oxycladon* (F_{11}), more commonly found in upland mesohabitat, have distinctly plicate and appressed leaves. In contrast, typical plants of *B. rivulare* have smooth apiculate leaves and a subdendroid growth form, but without the upright 'stem' with scale-like leaves of *Climacium dendroides* (C_{20}) or *C. americanum* (O_3). Orthophyllous modifications of *Drepanocladus aduncus* (C_{23}) also has smooth leaves with bulging alar cells, but these leaves are more lanceolate, less concave, and acuminate rather than apiculate. *Sciuro-hypnum plumosum* (O/F_{11}) has plicate leaves with a percurrent costa and *S. oedipodium* (C/F_{19}) has less well-developed alar-cell groups and twisted leaf tips. *Rhynchostegium aquaticum* (O_4) is similar, but sharply serrate and somewhat complanate.



left: typical smooth ovate-lanceolate stem leaves, quite imbricate

right: with a distinct apiculus (white arrow) and bulging alar-cell groups (red arrow)



typical emergent hydrophytic population in a black ash swamp



BRACHYTHECIUM RIVULARE

Associated Species: MesoHabit: *Plagiomnium ellipticum*, *Drepanocladus aduncus*, *Brachythecium salebrosum*; MicroHabit: *Callicladium haldanianum*, *Plagiomnium cuspidatum*; Pop: *P. ellipticum*, *D. aduncus*.



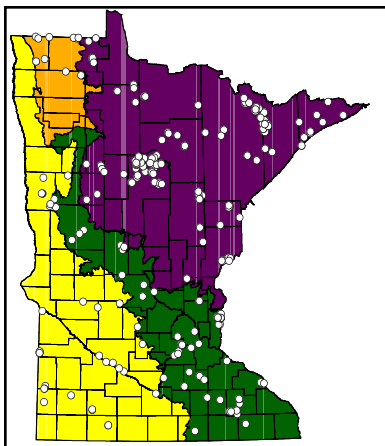
above and middle right: distinctly subdendroid growth form and plants from a alder-black spruce swamp

left: leaves highly variable on the same plant, only the stem leaves are typical

below right: pendent growth form in seepage of wet cliff with sporophytes (note the papillose seta)



BRACHYTHECIUM SALEBROSUM



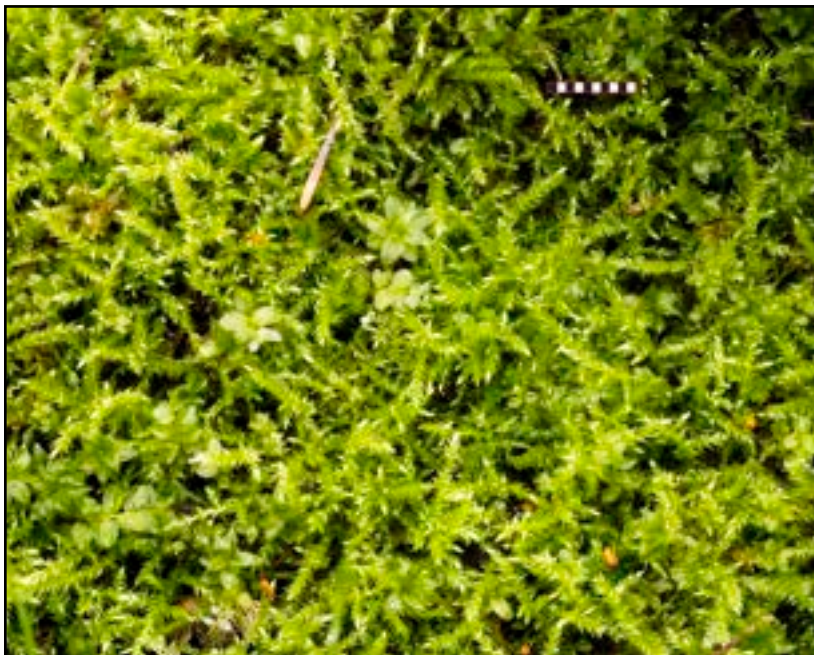
Abundance: Common (C_{25}).

Habitat and field aspect: Common in northern wet and southern seepage meadow/carr, northern and southern forested rich peatland (mostly associated with alder, tamarack, and black spruce), and wet forest (usually ash swamp). Frequent in northern mesic hardwood forest and in open rich peatland mainly in prairie extreme rich fen. Occasional in northern mesic mixed forest and dry to mesic mixed woodland, and northern acid peatland (usually poor conifer swamp). Recorded from southern dry savanna and wet prairie, on Lake Superior rocky and clay/mud river shore, in prairie mixed cattail marsh, and on southern mesic cliff and open talus. *Brachythecium salebrosum* forms mostly patches with **straggling branches** under thatch. The **yellow-green and glossy aspect** is characteristic, and makes it distinct from other bryophytes among which it grows.

Aid to Identification: There are **no paraphyllia nor rhizoids forming tomentum** on the main stems. On closer

inspection (20x handlens) the **ovate-lanceolate to lanceolate and straight, rarely somewhat curved leaves are bi-plicate to distinctly plicate**. The **costa** is faint, never percurrent, but **stopping in the upper half of the leaf**. The capsule is elevated on a **entirely smooth seta** (no roughness caused by papillae visible with the 20x), and when mature nearly black (before dehiscence of the spores) to brown when empty.

Look-Alike Species: *Brachythecium salebrosum* belonged to a large, unwieldy genus (some Minnesota species are now separated as *Sciuro-hypnum*, with a percurrent costa or twisted apex). Most specimens without mature sporophytes can only be identified tentatively. In wetlands *B. rivulare* (C_{21}) occurs frequently, and can be differentiated by its smooth leaves. *Brachythecium acuminatum* (C_{20}) and its somewhat larger look-alike *B.*



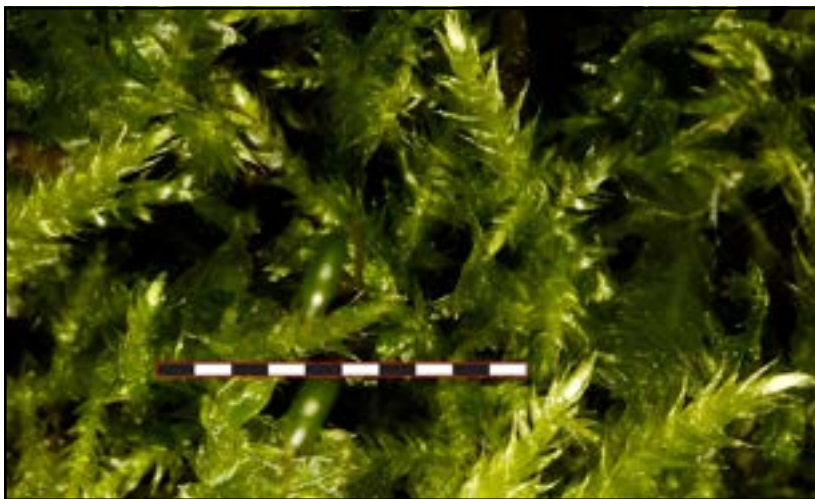
straggling yellow-green and highly glossy branches occurring among other bryophytes in a black-ash swamp



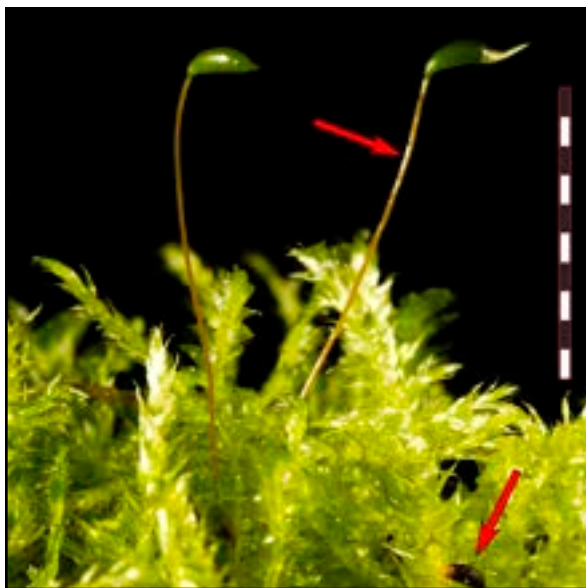
BRACHYTHECIUM SALEBROSUM

oxycladon (F_{11}) are more commonly found in upland mesohabitat. Their leaves are more distinctly plicate, and quite appressed to stem and branches when dry. The wetland species *B. erythrorrhizon* (C_{20}) and *B. falcatum* (O_5) have more strongly curved to falcate leaves, the latter also strongly multi-plicate.

Associated Species: MesoHab & Pop: *Plagiomnium ellipticum*, *Drepanocladus aduncus*, *Plagiomnium cuspidatum*, and *Ptychostomum pseudotriquetrum*; MicroHab: *Callicladium haldanianum*, *Plagiomnium cuspidatum*, *Hypnum pallescens*, and *Platygyrium repens*.

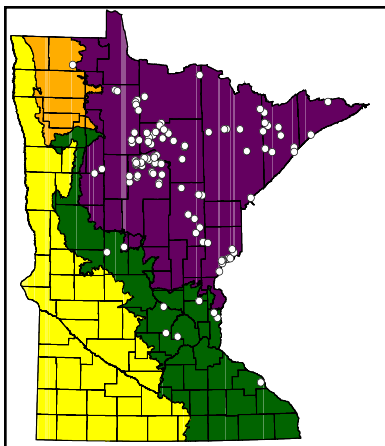


on close inspection the leaves are somewhat bi-plicate to plicate, rarely curved



the setae are smooth (upper arrow) and the capsules ovate-oblong cylindric, slightly curved and dark (lower arrow) when mature but before dehiscence

CALLIERGON CORDIFOLIUM



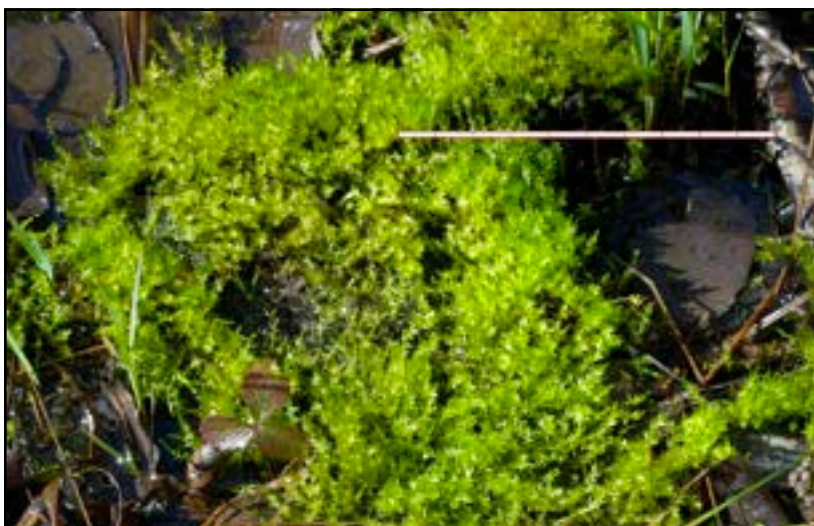
Abundance: Common (C_{17}).

Habitat and field aspect: Common in northern, north-western, and central forested rich peatland, mostly in tamarack and alder swamps, somewhat less common in rich spruce and cedar swamps. Frequent in northern wet forest, usually in ash swamps. Occasional in northern rich and shrub shore fen, and wet meadow/carr. Found in northern transitional fen and poor conifer forest. Recorded from northern mixed cattail marsh, and northern and central wet-mesic hardwood forest. Usually found in depressions, often flooded, on the swamp or forest floor. Large plants (up to 10 cm in length) with highly characteristic **straight and pointed branch and stem tips**. **Branching is irregular and sparse**.

Aid to Identification: The **youngest leaves** at the tip of branches and stems are **appressed and enrolled**, forming sharp points. However, when expanded and erect-spreading, the **older leaves clearly show an obtuse or rounded leaf apex**. When a leaf can be studied with the

20x handlens, it shows **large inflated and hyaline alar cells** near the attachment to the stem. The **costae are nearly percurrent**.

Look-Alike Species: Most similar is *Calliergon giganteum* (F_{13}), found in similar meso- and microhabitat. This species has more abruptly differentiated alar cells, but this is hard to see in the field. Most characteristic is its more, and radially pinnate, branching. It is usually also smaller than *C. cordifolium*, notwithstanding its name. *Calliergon richardsonii* (F_8) is also very similar, but has a short, sometimes branched costa, and the leaves are more widely ovate. *Calliergonella cuspidata* (F_{20}) is ecostate, and the stems have a flattened (complanate) aspect. It occurs more commonly in lawns and under thatch in calcareous fens and meadows rather than swamp depressions. *Straminergon stramineum* (F_{16}) is found in far less minerotrophic peatland mesohabitat, usually poor conifer swamp, associated with *Sphagnum*. Its leaves are narrower, not as obviously obtuse in the field as those of *C. cordifolium*. *Pseudocalliergon trifarium* (F_2) is a smaller, open rich peatland species, a calcareous-fen indicator, with very short costa and all leaves, even the older ones, strongly appressed to the stems, which appear as long skinny worms growing among other calcareous-fen species.



expanding clone in flooded depression on wet hardwood forest floor

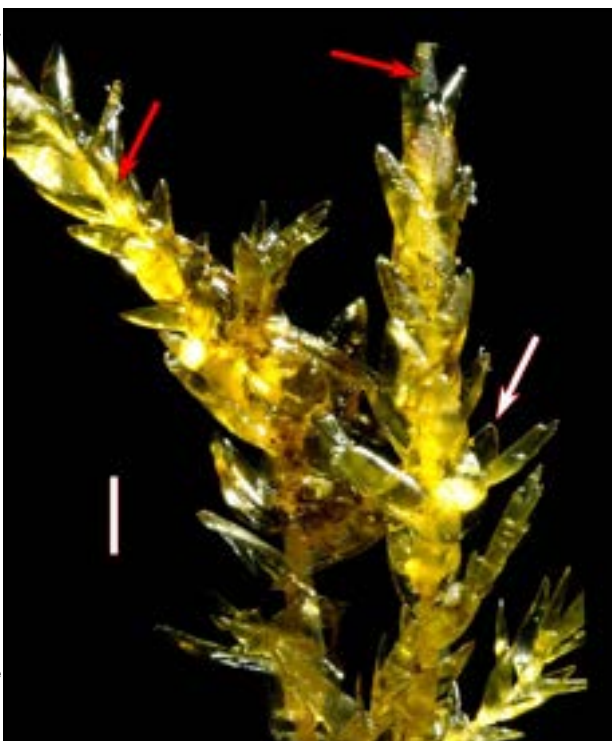


CALLIERGON CORDIFOLIUM

Associated Species: MesoHab: *Climacium dendroides*, *Plagiomnium ellipticum*, *Hypnum lindbergii*, *Callicladium haldanianum*, *Drepanocladus aduncus*; Pop: *Hypnum lindbergii*, *Plagiomnium ellipticum*, *Drepanocladus aduncus*.

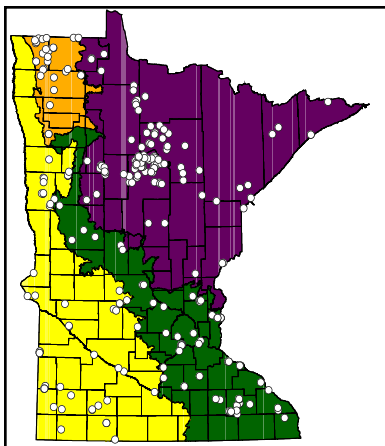
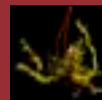


above: note the spear-shaped stem tips and the poorly developed branching



right: the older leaves are erect-spreading, sometimes even spreading, and then clearly show the obtuse apex (white arrow); with back-lighting it is possible to discern the percurrent costae (red arrows); the alar cells are hard to study in the field (20x handlens), particularly in this species of *Calliergon*, as they are not as abruptly differentiated from the distal laminal cells as in the related *C. giganteum* and *C. richardsonii*

DREPANOCLADUS ADUNCUS



Abundance: Common (C₂₃).

Habitat and field aspect: Abundant in northern wet and southern seepage meadow/carr, often the only bryophyte species present. Common in northern and prairie open rich fen and northern, northwestern, and southern forested rich peatland, and in northern and southern wet forest: a near-obligate calcareous fen indicator species. Occasional in northern poor fen and swamp, in transitional fen, in mixed cattail marsh, southern wet prairie, and northern terrace floodplain forest. A highly polymorphic species, but its common modifications are correlated to specific habitats. The emergent falcate form is found in open, minerotrophic wetland. The **orthophyllous (straight-leaved) modification** grows in dense shade under heavy thatch. Distinctly pinnately branched and upright stems form dense and pure carpets in calcareous- and spring-fen seepages.

Aid to Identification: Leaves either long and narrow lanceolate, or short ovate-lanceolate, and straight, curved, or falcate-secund. The costa doesn't reach the apex. On the largest leaves the alar cells form bulging groups (20x handlens).

Look-Alike Species: So common that field identifications usually turn out to be correct. However, there are a few look-alike species: *D. sordidus* (O₂) with falcate-secund leaves but a much smaller alar-cell group, a feature not easily seen in the field with a handlens. It is only recently recognized and its habitat is not yet differentiated from that of *D. aduncus*. In calcareous and spring fens *D. aduncus* can look very similar to *Cratoneuron filicinum* (F₉). The latter usually has stem paraphyllia, and its leaves are somewhat plicate and its costae are stout. The plants also feel a lot stiffer than those of *D. aduncus* because of the encrusted CaCO₃ precipitate. The costae of *D. aduncus* are never percurrent or excurrent, so any collections with such a feature might be the rare *Drepanocladus longifolius* (U₂), *Warnstorfia fluitans* (F/O₁₂), or *Sarmentypnum exannulatum* (F₁₂), species occurring along lake shores and in poor-fen pools. Orthophyllous modifications might be confused with *Hygroamblystegium varium* mod. 'tenax', (F₁₄), with percurrent and stout costa, and *Leptodictyum riparium* (F₁₇), with less bulging alar cells and often a complanate aspect to the plants, usually found in gently flowing water.

Associated Species: MesoHabit: *Plagiomnium ellipticum*, *Brachythecium salebrosum*, *Ptychostomum pseudotriquetrum*; Pop: *Plagiomnium ellipticum*, *Brachythecium salebrosum*, *Brachythecium rivulare*.



typical emergent form in open wetland mesohabitat with distinctly branched stems and falcate-secund leaves



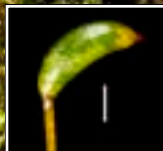
DREPANOCCLADUS ADUNCUS



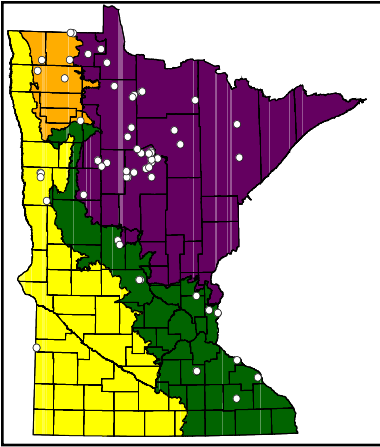
above: highly shaded form, often with straight leaves found under dense thatch (branch inset)

left: upright pinnately branched stems of a spring-fen seepage population with falcate-secund leaves (branch inset)

below: wet-meadow orthophyllous modification with a dense cluster of immature sporophytes (inset typical curved capsule)



HELODIUM BLANDOWII



Abundance: Frequent (F_{16}).

Habitat and field aspect: Frequent in northern and northwestern forested rich peatland, particularly in tamarack and rich conifer swamp, less so in northern rich spruce and alder swamp, and in southern rich conifer swamp. In open rich peatland occasional in northern and prairie rich and extreme rich fen. Found in northern, southern, and prairie meadow/car, and northern and southern wet forest. Recorded from northern transitional fen. Often forming **large, isolated low hummocks** among low shrubs. Most plants **grow densely packed and upright**, often with a **characteristic swollen stem apex**.

Aid to Identification: **Distinctly uni-pinnately branched** (the var. *helodioides* (O/U₃) less so). The stems, branches, and often the lower part of the stem leaves are **densely covered by filamentous paraphyllia** which, when wet, appear darkly colored and in mass might be confused with tomentum. Upon **drying**, however, they more clearly show their affinity with the leaves and the plants take on a **matte appearance** because of papillose

leaf cells.

Look-Alike Species: Its commonly occurring dense growth form in low hummocks is reminiscent of the weft-forming feather mosses. These species, however, usually occur on mesic to wet forest floor rather than in hygrophytic swamp and rich-fen where *H. blandowii* is commonly encountered. *Ptilium crista-castrensis* (C_{14}) is the most obviously pinnate feather-moss similar to *H. blandowii*, but its leaves are strongly plicate and falcate-secund. It is also without paraphyllia. The paraphyllose and matte *Hylocomium splendens* (C_{12}) and the large *Thuidium* species, *T. delicatulum* (C_{21}) and *T. recognitum* (C_{20}), are distinctly tri-pinnately branched. *Pleurozium schreberi* (C_{19}) is branched irregularly, and very glossy when dry. Among the rich-fen species only the congener *H. paludosum* (F_8) and *Tomentypnum nitens* (F_{11}) have a somewhat distinctive pinnate branching. The former is similar to the var. *helodioides* with less well-developed pinnate branching and narrower, long-acuminate stem leaves, and can only be differentiated using microscopic characters related to cell characteristics. The latter, *Tomentypnum nitens*, is densely tomentose on one side of the stem, and the leaves are deeply plicate. Other costate wetland pleurocarps with a pinnate aspect in Minnesota have no or a far-less dense paraphyllose stem cover and non-papillose cells, and are as such more glossy when dry.

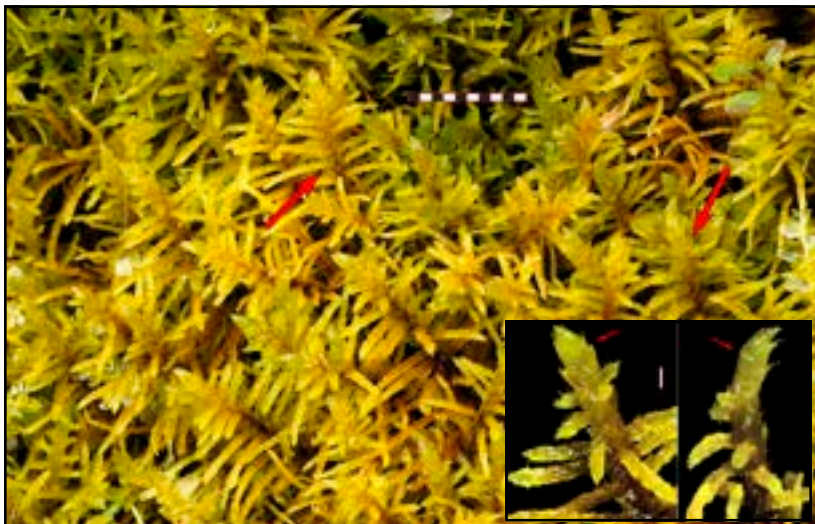


large isolated hummock among dense thatch and shrub cover in calcareous fen

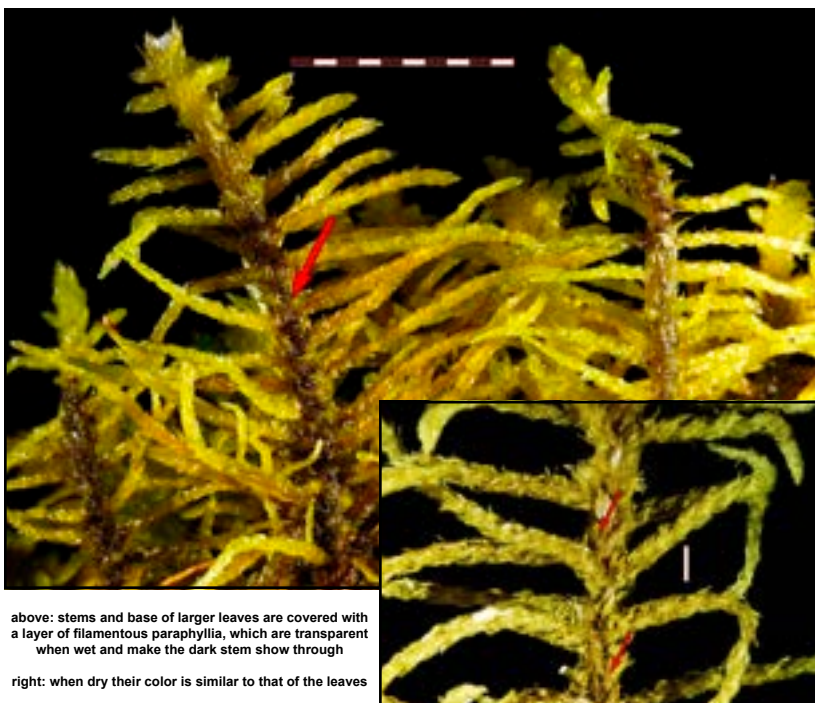


HELODIUM BLANDOWII

Associated Species: MesoHab: *Plagiomnium ellipticum*, *Ptychostomum pseudotriquetrum*, *Drepanocladus aduncus*, *Aulacomnium palustre*, and *Hypnum lindbergii*; Pop: *Plagiomnium ellipticum*, *Aulacomnium palustre*, *Tomentypnum nitens*, *Sphagnum warnstorffii*, and *Drepanocladus aduncus*.



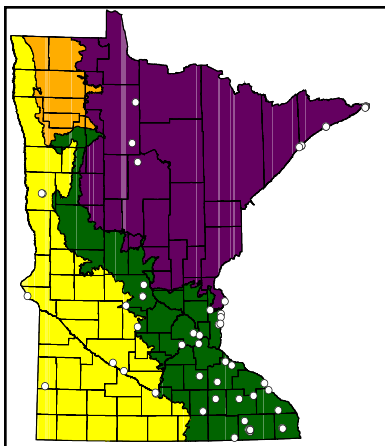
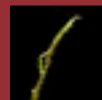
the stems are often densely packed and upright, distinctly uni-pinnately branched ; inset: the apex of the stem is often appearing swollen because of the large costate stem leaves and short branch buds while internodes are still short



above: stems and base of larger leaves are covered with a layer of filamentous paraphyllia, which are transparent when wet and make the dark stem show through

right: when dry their color is similar to that of the leaves

HYGROAMBLYSTEGIUM VARIUM MOD. 'TENAX'



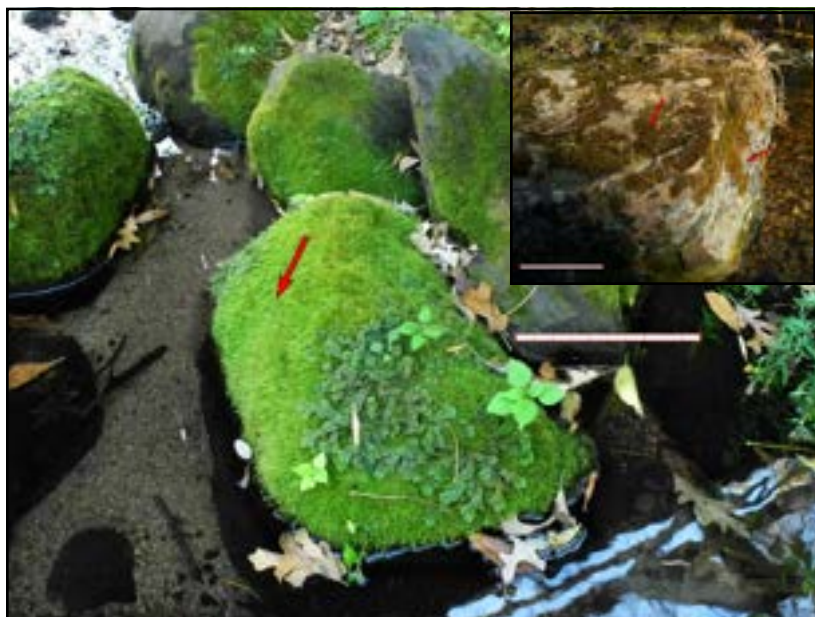
Synonyms: *Amblystegium tenax*, *Hygroamblystegium tenax*.

Abundance: Frequent (F₁₄)

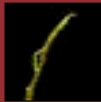
Habitat and field aspect: Frequent along Lake Superior shore and river rocky shore. Occasional on different southern cliff and talus mesohabitat and on northern wet cliff. Found in southern wet/meadow carr and wet to dry mesic hardwood and oak forest. Recorded from southern floodplain forest and northern mesic prairie, very wet ash and cedar/fir swamp. Both the Minnesota geographical distributions and mesohabitat preferences (see under *Amblystegium varium*) underscore the close relationship between these two taxa: 'tenax' appears to be a more forceful **hygrophytic modification of 'varium'**. It grows in **flooded depressions, seepages, and even running water of creeks**. It is more associated with **mineral-substrate wet or aquatic microhabitat** than any of the other species considered here in the field guide as 'wetland' costate pleurocarps.

Aid to Identification: The **costa is stout**, not yet particularly wide (see below, 'fluviatile' modification), but **percurrent to shortly excurrent**. Often these costae are all that remains of the leaves along the older part of the tough stems attached to the rocky substrate. The **base of the leaf is slightly colored** in contrast with the rest of the lamina.

Look-Alike Species: *Hygroamblystegium 'tenax'* is now considered a hygro-hydrophytic modification of *Hygroamblystegium varium* subsp. *varium* var. *varium*. It is likely to be part of a cline of structural modification from the small semi-terrestrial (wetland) mod. 'varium' (C₁₀), through hydrophytic 'tenax' and 'fluviatile' (O₁, with a wide percurrent costa and narrowly obtuse apex), to maybe the large *Hygroamblystegium noterophilum* (O/U₂), with even a stouter, excurrent costa. However, meso- and microhabitat preferences are clearly different among these forms, certainly between 'varium' and the more hygro-hydrophytic modifications, so



on rocks in intermittent stream bed

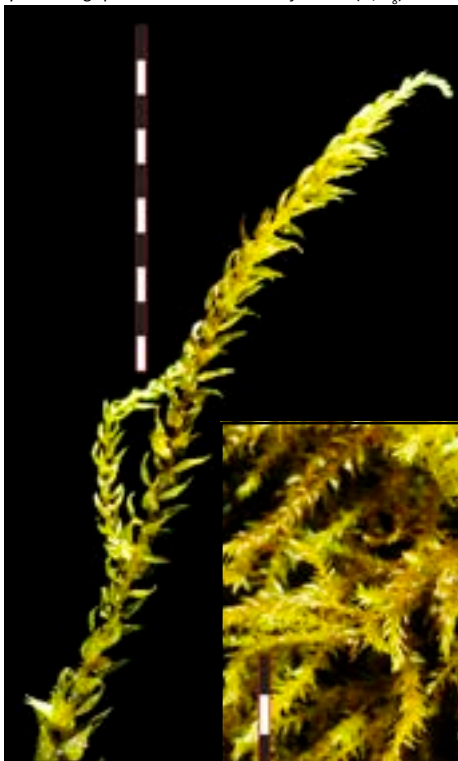


HYGROAMBLYSTEGIUM VARIUM MOD. 'TENAX'

that it is still convenient to differentiate them. A few other mosses with aquatic modifications when attached to rocks in running water show eroded leaves with naked costae: *Fissidens* species (such as the aquatic *Fissidens fontanus* (U_1), but also the large *F. adianthoides* (F_{16}) or small *F. bryoides* (O_3), with distichous leaf arrangement) and *Dichelyma falcatum* (O/U_3 , with falcate-secund, keeled and conduplicate leaves). Several costate deep-water and river mosses considered under the old concept of 'brown mosses' or Amblystegiaceae s.l. (*Drepanocladus* s.l.) might have naked costae among the old leaves, but usually some of their younger leaves are more obviously curved or falcate, and usually far more narrowly-lanceolate than those of *Hygroamblystegium*. *Hygrohypnum luridum* (O_1) has shorter ovate-lanceolate and curved leaves, with weak single or double costae. *Rhynchostegium serrulatum* (O_4) and *Brachythecium rivulare* (C_{21}) have also more ovate-lanceolate but straight leaves, with weaker costae. *Leptodictyum riparium* (F_{17}) has straight, narrowly lanceolate leaves, but with weak costae and a somewhat complanate leaf arrangement. In seepage frequently occurring species such as *Philonotis fontana* (O/U_8) and its varieties *caespitosa* (O/U_3) and *pumila* (O_1), and

Pohlia wahlenbergii (O_2) are easily differentiated from *Hygroamblystegium* in field aspect by their acrocarpous and distinctly red stems and paler green leaves. *Cratoneuron filicinum* (F_9 , stout costa and curved-secund leaves) and the very similar seepage modification of *Drepanocladus aduncus* (C_{23} , falcate-secund leaves) are distinctly pleurocarpous, often with pinnate branching.

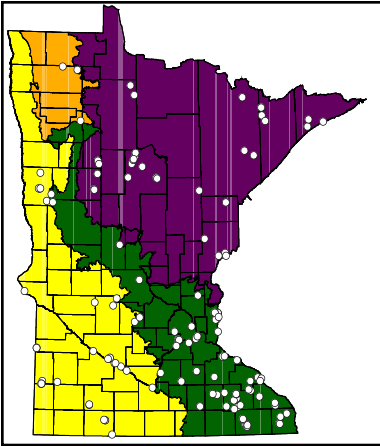
Associated Species: MesoHab: *Brachythecium rivulare*, *Plagiommium cuspidatum*, *Brachythecium acuminatum* (in drier mesohabitat), *Hygroamblystegium varium* mod. 'varium', *Hypnum lindbergii*, *Ptychostomum pseudotriquetrum*; Pop: *Brachythecium acuminatum*, *Brachythecium rivulare*, *Ptychostomum pseudotriquetrum*, *Hypnum lindbergii*.



poorly branched plants firmly attached to the rocky substrate with stiff leaves with stout costae, somewhat brown colored at the base



HYGROAMBLYSTEGIUM VARIUM MOD. 'VARIUM'



Synonym: *Amblystegium varium*.

Abundance: Common (C₂₀).

Habitat and field aspect: Common in northern and southern wet meadow/carr, also in some prairie and basin wet meadows. Frequent in mesic hardwood forest in all regions. Occasional in northern wet and rich conifer forest and swamp, and in northern and southern wet-ash, ash, and tamarack swamp, in prairie extreme rich fen (an near-obligate calcareous fen indicator in Minnesota), and on southern open, algific and moderate cliff/talus. Recorded from fire-dependent forest/woodland in all regions, rocky and clay/mud river shore, northern and southern terrace floodplain forest, northern and prairie cattail marsh, and southern wet prairie. A small unobtrusive species, usually hiding under thatch, attached as **small soft clones** to organic debris, such as old *Carex* culms, and to the base of shrubs. **Frequently with sporophytes.**

Aid to Identification: The **leaves are straight, erect to**

erect-spreading (internodes usually clearly visible), ovate-lanceolate, smooth, and without bulging alar-cell regions. The **costae are nearly percurrent**, and on close inspection (20x handlens) often **show a curve in the upper part of the leaf.**

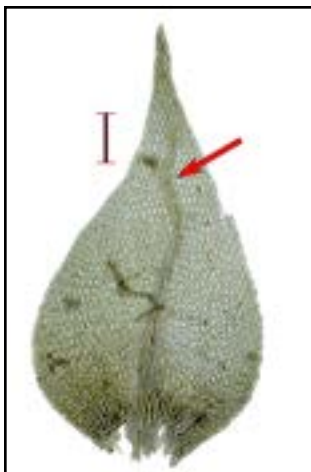
Look-Alike Species: Other related *Hygroamblystegium* species (presently nearly all considered modifications of *H. varium*, see *H. varium* mod. 'varium') usually occur as aquatics, often in flowing water. Their costae are very stout, often remaining on the older parts of the stems long after the laminae have eroded away. Some small orthophyllous modifications of *Drepanocladus aduncus* (C₂₃) appear very similar of *H. varium* mod. 'varium', both in structure and in microhabitat preferences. However, its costae are only reaching somewhat above the middle of the leaf rather than percurrent, and bulging alar-cell regions can be observed on some of the leaves. The straight-leaved costate *Brachythecium* species found in wetland mesohabitat also have a shorter costa, and their leaves are either plicate or highly glossy because of a much longer cell type than those of *H. varium* mod. 'varium'. Most similar in structure to *H. varium* are more rare wetland species such as *Amblystegium serpens* (F₂₁, smaller, with short costa), and *Leptodictyum riparium* (F₁₇, larger, with straight



small clone growing on fallen woody debris in a wet forest



HYGROAMBLYSTEGIUM VARIUM MOD. 'VARIUM'

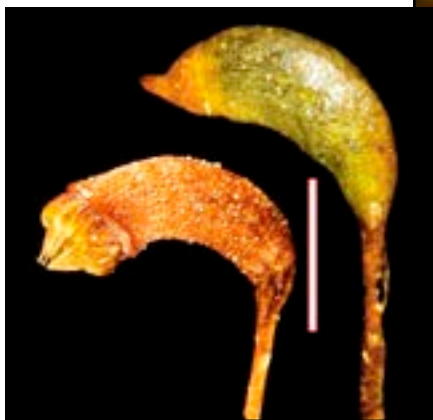


poorly branched pleurocarp with spreading ovate-lanceolate leaves with nearly percurrent costa often having a slight curve above (see arrows)

costa and a longer cell type, the leaves often somewhat homomallous). Shorter-leaved material similar to *L. riparium*, previously called *L. humile*, is now considered formally *Hygroamblystegium varium* subsp. *varium* var. *humile* (F₁₁).

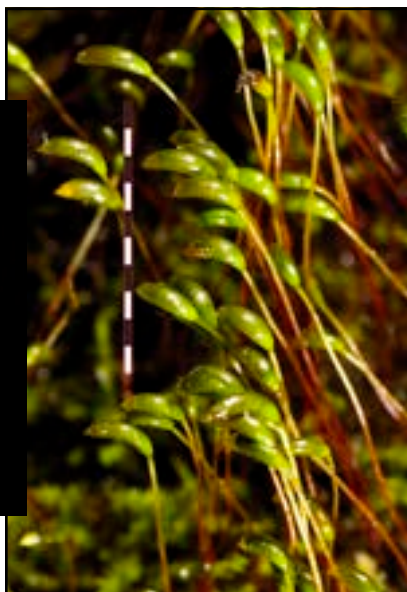
Pseudocampyllum radicale (F₁₈) is differentiated from *A. varium* by its decurrent leaves.

Associated Species: MesoHab: *Plagiomnium cuspidatum*, *Brachythecium salebrosum*, *Plagiomnium ellipticum*, and *Drepanocladus aduncus*; Pop: *Plagiomnium cuspidatum*, *Brachythecium salebrosum*, *Plagiomnium ellipticum*, and *Brachythecium acuminatum*.

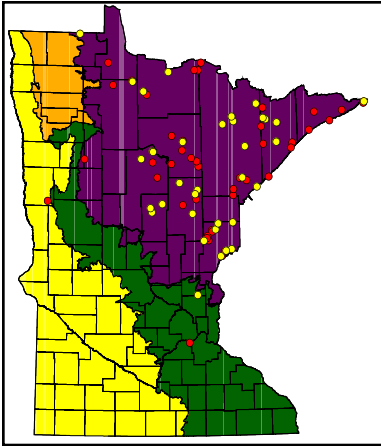


right: clones frequently with abundant and large sporophyte

above: mature capsule with operculum and old capsule with typical hypnaceous peristome (double peristome)



SARMENTYPNUM EXANNULATUM AND WARNSTORFIA FLUITANS



red = *S. exannulatum*, yellow = *W. fluitans*

Synonyms: *Drepanocladus exannulatus*, *Warnstorfia exannulata*, and *Drepanocladus fluitans*.

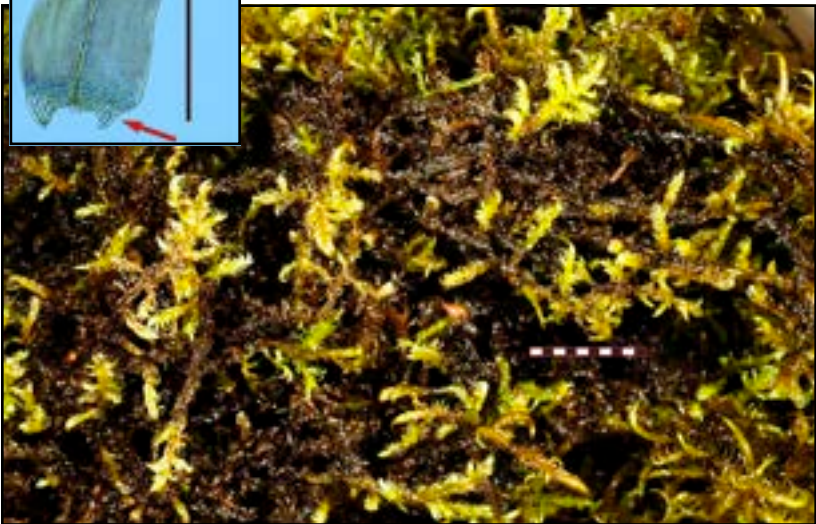
Abundance: Frequent (F_{12}) and Frequent/Occasional (F/O_{12}).

Habitat and field aspect: Both species occur in northern forested rich peatland and acid peatland, mostly associated with tamarack and black spruce, less with cedar/fir: *Sarmentypnum exannulatum* frequently in rich peatland, *Warnstorfia fluitans* rather in more acidophilous mesohabitat, such as northern poor conifer swamp and transitional fen. Both are recorded along Lake Superior rocky shore, and in northern wet meadow/carr and rich fen. *Sarmentypnum exannulatum* also in shrub shore fen and in the south of the state found in calcareous fens. **Submerged- to semi-emergent populations** can form **large carpets along edges of mire pools and along lake margins**. *Sarmentypnum exannulatum* is also growing as a **deep-water aquatic**, found either by diving or washed-up on shore when broken loose after storms.

Aid to Identification: Large plants with **long-lanceolate and strongly falcate-secund leaves**. The stems have **no paraphyllia or tomentum**. **Alar-cell groups large and bulging**.

Look-Alike Species: Both species are very similar. The diagnostic characters are microscopic, but in the field it might be possible to see, with the 20x handlens, the large bulging and sharply outlined alar-cell groups of *S. exannulatum*. The alar cells of *W. fluitans* are less obvious, its costa reaches not as far up in the leaf which is more ovate-lanceolate, with a distinctly narrowed insertion on the stem. Other species approaching

the field aspect of *S. exannulatum*, such as *Drepanocladus longifolius* (U_2), *Warnstorfia pseudostraminea* (U_3), *W. tundrae* (U_3), *Hamatocaulis vernicosus* (F_{10}) and modifications of the *Drepanocladus aduncus* (C_{23}), sometimes have leaves with excurrent costae or straight leaves with hooked apices, but often critical identification with microscope is needed.

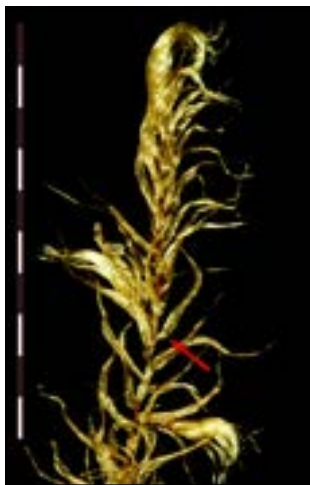


semi-emergent population of *S. exannulatum* under thatch in a wet meadow; large, bulging alar-cell groups (red arrow) might be visible with the 20x handlens in the field (inset microscope image)



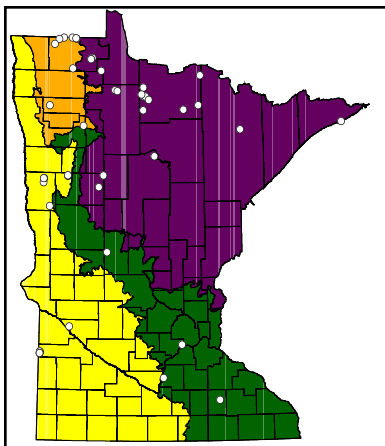
SARMENTYPNUM EXANNULATUM AND WARNSTORFIA FLUITANS

Associated Species: for *S. exannulatum*: MesoHab: *Sphagnum magellanicum*, *Callicladium haldanianum*, *Pleurozium schreberi*, *Sphagnum angustifolium*; Pop: *Sphagnum subsecundum*, *S. angustifolium*, *Campylium stellatum*; for *Warnstorfia fluitans*: MesoHab: *Aulacomnium palustre*, *Sphagnum angustifolium*; Pop: *Calliergon stramineum*, *C. cordifolium*, *Sphagnum subsecundum*.



most leaves are narrowly lanceolate and strongly falcate-secund, the young ones tightly enroled
above and below left: in *S. exannulatum* stems and leaves are often with red pigment
below right: leaves of *W. fluitans* are narrower, with a contracted base and less stout costa

SCORPIDIUM COSSONII



Synonyms: *Drepanocladus revolvens* var. *cossonii*, *Limprichtia cossonii*.

Abundance: Frequent (F₃).

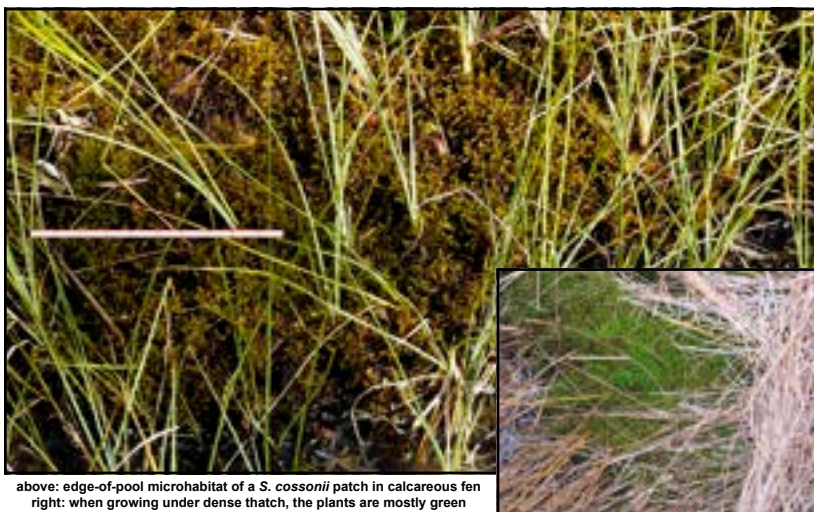
Habitat and field aspect: Frequent in open rich peatland in northern extreme rich-fen mesohabitat, and in prairie rich fen and extreme rich fen and northern water track. A near-obligate calcareous- and spring-fen indicator. Occasional in forested rich peatland such as cedar/fir and rich black spruce swamp. Recorded from transitional fen and southern seepage meadow. **Sub-pinnately branched plants** growing in **soft, pure mats slightly emergent** near the edge of rich-fen pools, of a **golden-brown color**. Rarely hidden **underneath dense thatch and then green**.

Aid to Identification: The **costate leaves** (costae not easily visible) are nearly **circinate and secund**. **Stem and branches are without paraphyllia**. There are **no large or obvious alar-cell groups** (20x handlens).

Look-Alike Species: *Scorpidium cossonii* was part of the *Drepanocladus revolvens* complex. *Scorpidium revolvens* s.s. (O/U₃) can only be differentiated reliably from *S. cossonii* by using technical and microscopic characters.

However, *S. revolvens* appears to be consistently found in less minerotrophic peatland, and develops often a purple-red pigment, not seen in *S. cossonii*. *Scorpidium scorpioides* (F₈) is a larger, poorly branched plant, with ecostate leaves, growing in extreme rich-fen pools as an aquatic, rather than semi-emergent along the pool edges as *S. cossonii*. Some populations of these two species can look very similar, however, and need to be closely scrutinized. *Pseudocalliergon turgescens* (O/U₃) is smaller than *S. scorpioides*, more similar to *S. cossonii*, but straight-leaved. *Drepanocladus aduncus* (C₂₃) modifications, and *D. sordidus* (O₅), have distinct falcate-secund and costate leaves, but never as circinate as those of *S. cossonii*. They also never have the rich golden-brown color and grow in a much greater variety of mesohabitat than *S. cossonii*. *Sanionia uncinata* (C₁₂) has similarly circinate leaves (sometimes distinctly plicate) at the tip of its branches as *S. cossonii*, but is a species found in mesic forested upland rather than peatland. The apices of its youngest leaves are sharply serrate, while those of *S. cossonii* are entire (20x handlens needed). *Hamatocaulis vernicosus* (F₁₀), *Sarmen-typnum exannulatum* (F₃₂) and *Warnstorfia fluitans* (F/O₁₂) are also species quite similar in field aspect to *S. cossonii*: the first more delicately and pinnately branched, the latter two larger with usually less circinate and long-lanceolate leaves and enlarged alar-cell groups. *Hypnum lindbergii* (C₂₃) occurs in similar mesohabitat as *S. cossonii* and often has a very similar aspect, but its leaves are ecostate (it is also always green rather than golden-brown)

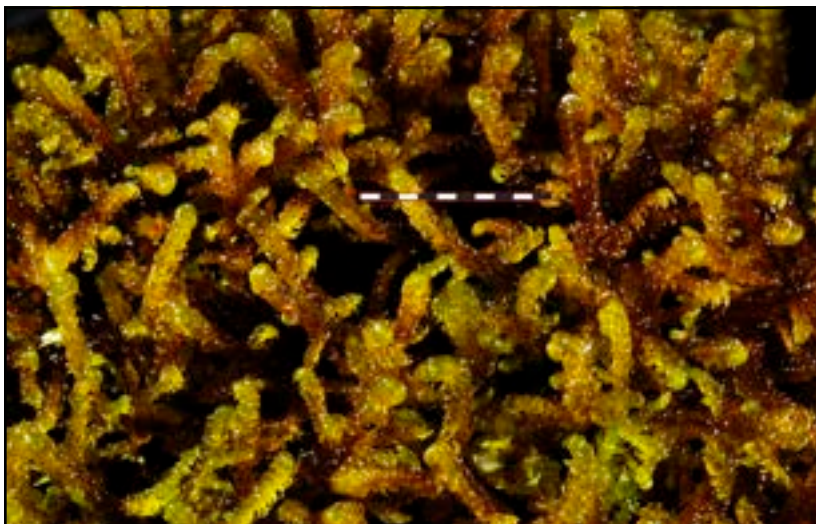
Associated Species: MesoHab and Pop: *Campyllum stellatum*, *Ptychostomum pseudotriquetrum*.



above: edge-of-pool microhabitat of a *S. cossonii* patch in calcareous fen
right: when growing under dense thatch, the plants are mostly green



SCORPIDIUM COSSONII

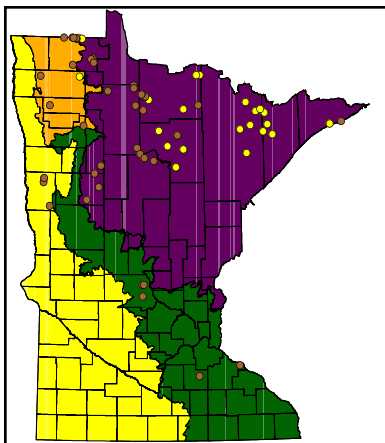


above and left: typical golden-brown color and swollen look of *S. cossonii* stem and branches

below right: with the strongly curved- (fal-cate- to circinate-) second leaves at the hooked tip of the stems; a costa is distinctly visible, pointed out by the blue arrow, but would not be seen on leaves of a *Scorpidium scorpioides* of similar aspect



TOMENTYPNUM NITENS AND T. FALCIFOLIUM



brown = *Tomentypnum nitens*, yellow = *T. falcifolium*

Synonyms: Genus name earlier spelled as *Tomenthypnum*.

Abundance: Frequent (F_{11} and F_9).

Habitat and field aspect: Both species frequent in northern and northwestern forested rich peatland: in tamarack and black spruce swamp, and typically found in their small spring-fen openings. Occasional in northern open rich peatland such as rich and extreme rich fen. Here *T. falcifolium* is restricted to less minerotrophic rich-fen mesohabitat, and is also quite often found in northern poor fen and conifer swamp of the acid peatland system. *Tomentypnum nitens* is also recorded in prairie extreme rich fen and southern seepage meadow (a facultative calcareous-fen indicator in Minnesota). Forming usually pure and low hummocks on elevated parts of spring fens and on strings in patterned peatlands, and *T. falcifolium* also found as scattered plants in *Sphagnum* hummocks. The **golden-brown color and stiff aspect** of the large plants is recognizable from a good distance.

Aid to Identification: Positive identification is accomplished by the **highly diagnostic dark-brown tomentum**, found **along the entire underside of the stem**. The **stems are somewhat pinnately branched**, and often

grow nearly upright in densely packed clones. The **erect and straight (*T. nitens*) or curved (*T. falcifolium*) leaves are narrowly lanceolate and distinctly plicate**.

Look-Alike Species: The only diagnostic field difference of *T. falcifolium* from *T. nitens*, apart from habitat preferences, are the curved- to falcate-second leaves. Some slightly curved leaves might also be observed on plants of *T. nitens*. In calcareous fens *Campylium stellatum* (C_{21}) is a species similar in aspect, color, and microhabitat as *T. nitens*. Its leaves, however, have long subulate apices, with distinct concave shoulders, in contrast with the narrow and straight lanceolate leaves of *T. nitens*. They are also ecostate, but some other *Campylium*-like species (now separated into other genera in the FNA), are costate, and might be confused with *T. nitens*. None of them, however, are as strongly plicate or tomentose as the two *Tomentypnum* species. *Aulacomnium palustre* (C_{22}) is the only other common peatland species with a distinctive tomentum, in this case nearly black, offset against the bright green of the young stems. This moss is growing in small turfs as an acrocarp (branching by innovation), and its leaves are usually somewhat wrinkled, dry and wet, and of a matte aspect.

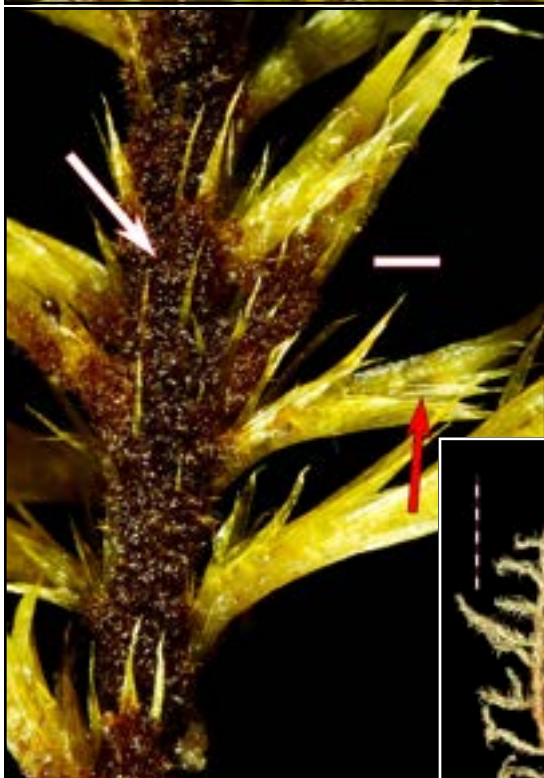
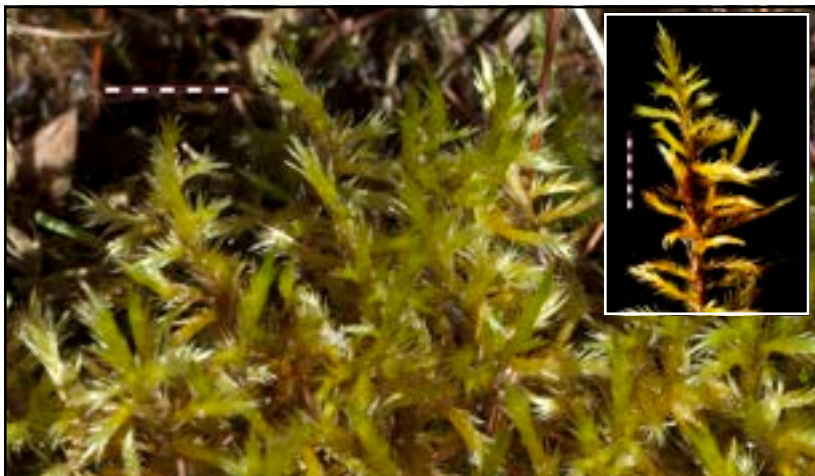


golden-colored low hummock in spring-fen opening, formed by stiff, densely packed stems



TOMENTYPNUM NITENS AND T. FALCIFOLIUM

Associated Species: for *T. nitens*: MesoHab: *Ptychostomum pseudotriquetrum*, *Aulacomnium palustre*, *Campylium stellatum*, *Sphagnum warnstorffii*; Pop: *Helodium blandowii*, *Aulacomnium palustre*, *Sphagnum warnstorffii*; for *T. falcifolium*: MesoHab: *Aulacomnium palustre*, *Sphagnum angustifolium*, *S. magellanicum*, *Pleurozium schreberi*; Pop: *Aulacomnium palustre*, *Sphagnum angustifolium*, *S. magellanicum*.



above: the plants are often closely packed, growing erect, and somewhat radially-pinnately branched

left: one side of the stem (the lower side of those stems that grow prostrate) is covered by dense, dark-brown tomentum (white arrow) and the leaves are narrowly lanceolate, distinctly plicate (with longitudinal folds, which makes the costa hard to differentiate (red arrow)

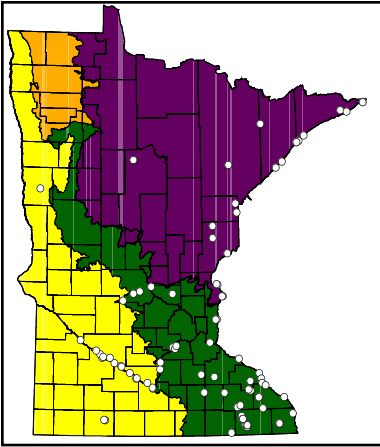
below: the falcate-second leaves of *T. falcifolium*





COSTATE UPLAND PLEUROCARPS

ANOMODON ATTENUATUS



Abundance: Common/Frequent (C/F₁₇).

Habitat and field aspect: Common on southern mesic cliff and open talus, and in southern and central mesic hardwood forest. Frequent along Lake Superior rocky shore and in southern terrace forest. Recorded from northern wet cliff, very wet ash swamp, and wet meadow/carr; from rocky river shore, southern moderate cliff and bedrock outcrop. Most commonly recognized as large, **rough-mat and irregularly branched** patches covering the lower, mesic part of hardwood tree trunks in mesic forest. However, many smaller populations are found on rocks, on cliffs, and on mineral forest floor. Most often observed **when dry, and then appearing shriveled, curly, and dusty**. The **attenuated branches** are **most clearly differentiated when the plants are wet**.

Aid to Identification: When wet the **regular leaves are somewhat homomallous** in orientation (turned to one direction), and usually end in a **acute point or short apiculus, sometimes coarsely serrate, at the end of a lingulate or gradually tapering acumen**. This **acumen is offset from the broadly ovate leaf base by distinct**

shoulders. The costae are hyaline and distinct.

Look-Alike Species: Most similar in structure and microhabitat preference to the somewhat more common *A. minor* (C₂₂). The latter lacks the attenuated branches, and its leaf tips are obtuse, rather than acute/apiculate. *Anomodon rostratus* (F₁₁) has an excurrent, hyaline-tipped costa and is a smaller plant. It is also found more commonly restricted to cliffs. All three *Anomodon* species are distinctly matte, both wet and dry, and thus easily differentiated from *Brachythecium* and related species that are frequently found in similar habitat. Other matte species covering tree trunks are usually far smaller species (leaves usually < 1 mm or narrowly (ovate)-lanceolate). Only the large matte liverwort *Porella platyphylla* (with large distinct underleaves, F₂₀) and highly glossy moss *Neckera pennata* (with highly complanate, ecostate and undulate leaves, F₁₃) are of similar size and found next to or often intermixed with *Anomodon attenuatus* or *A. minor* patches.

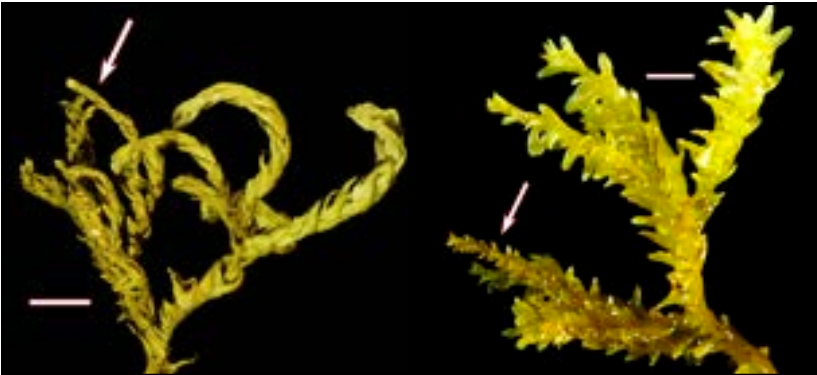
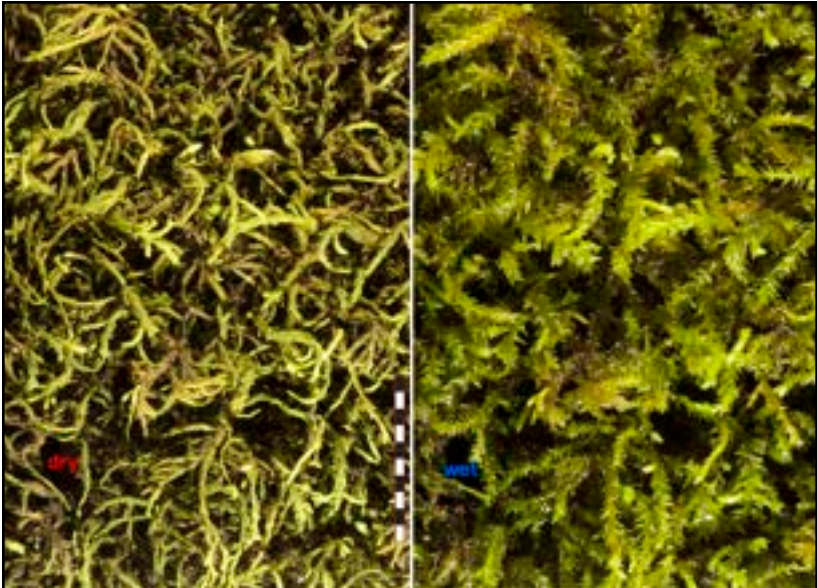
Associated Species: Mesohab: *Plagiomnium cuspidatum*, *Brachythecium acuminatum*, *Anomodon minor*, *Platygyrium repens*; Microhab: *Callicladium haldanianum*, *Plagiomnium cuspidatum*, *Hypnum pallenscens*, *Platygyrium repens*, *Brachythecium acuminatum*, *Brachythecium erythro-rhizon*, *Ptilidium pulcherrimum*, *Sa-nionia uncinata*, *Dicranum flagellare*, *Sciuro-hypnum reflexum*, *Lophocolea heterophylla*; Pop: *Brachythecium acuminatum*, *Plagiomnium cuspidatum*.



common in mesic hardwood habitat



ANOMODON ATTENUATUS



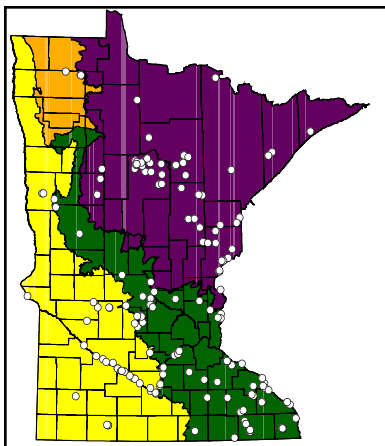
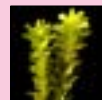
top: when dry appearing shriveled and matte, but distinctly expanded when wet

middle: attenuated branch

right: the attenuated branches have leaves much smaller than the regular branches; the regular leaves are distinctly costate, the costa appearing hyaline



ANOMODON MINOR



Abundance: Common (C_{22}).

Habitat and field aspect: Common in southern and central dry to mesic hardwood forest, and in northern and northwestern wet forest. Frequent in northern and southern floodplain forest, and on southern cliff and open talus. Occasional in southern and central dry-mesic fire-dependent forest/woodland. Recorded from northern wet meadow/carr and southern rich conifer swamp. Usually **rough-looking mats forming extensive patches on the boles of hardwood trees**, in swamps on older ash trees. Less frequently encountered on coarse woody debris or on the terrestrial mineral forest floor.

When dry the plants have a very different aspect, as the leaves contort and become closely appressed to the stem and branches. This species is mostly responsible for the dramatic difference in apparent moss-cover between the dry tree trunks and their aspect immediately after wet weather.

Aid to Identification: When wet the **branches are easily several mm wide with broadly lingulate, complanate leaves**. Their **acumen** nearly always ends in a **rounded, obtuse apex**. The **costae** are obvious in the light-green

matte laminae, as they consists of **nearly hyaline cells**. **Flagelliform branches are absent, but the capsules**



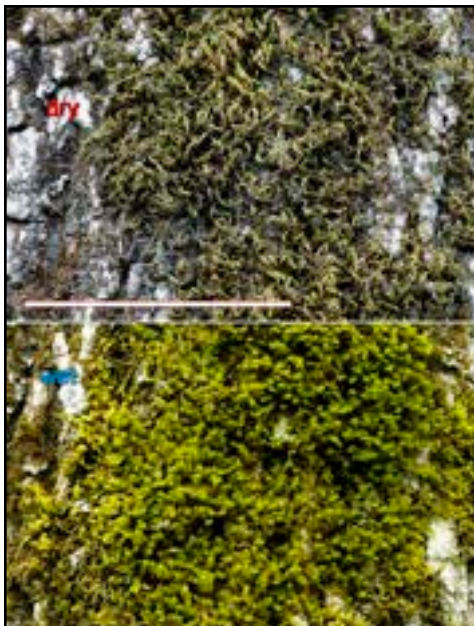
often covering the lower part of the mesic side of hardwood tree trunks

Look-Alike Species: Somewhat larger than its close relative *A. attenuatus* (C/F_{17}) and without the attenuated, flagelliform branches (with very small leaves) of the latter. *Anomodon rostratus* (F_{11}), the only other *Anomodon* species recorded so far in Minnesota, is quite a bit smaller, and its acuminate leaves have an excurrent costa, ending in a hyaline tip. *Anomodon rugelii* (brittle and crispate when dry, with broadly auriculate leaves) and *A. viticulosus* (with falcate-secund large leaves, > 2 mm, with narrowed acumen, not appressed when dry) have been recorded from Michigan and Wisconsin and are quite similar in overall structure to *A. attenuatus* and *A. minor*. These species should be looked for in the state. *Anomodon* species are distinctly matte, both wet and dry, and larger than most other species found on tree trunks. Only the large matte *Porella platyphylla* (a liverwort with distinct underleaves, F_{20}) is of similar size. *Necckera pennata* (with highly complanate, ecostate and undulate leaves and sessile sporophytes, F_{13}), found next to or often intermixed with *Anomodon* is also of similar size, but highly glossy. All other corticolous species covered in the keys to upland pleurocarps are a lot smaller, or glossy, or ecostate, or with terete (rounded) branches and often pinnately branched.

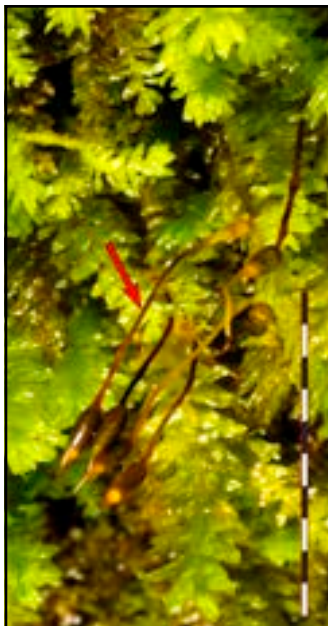


ANOMODON MINOR

Associated Species: Mesohab: *Plagiomnium cuspidatum*, *Platygyrium repens*, *Brachythecium acuminatum*, *Haplocladium microphyllum*, *Entodon cladorrhizans*, *Hygroamblystegium varium* mod. 'varium'; Microhab: *Callicladium haldanianum*, *Plagiomnium cuspidatum*, *Hypnum pallescens*, *Platygyrium repens*, *Brachythecium acuminatum*, *Dicranum flagellare*, *Ptilidium pulcherrimum*, *Brachythecium erythrorrhizon*, *Sanionia uncinata*; Pop: *Brachythecium acuminatum*, *Porella platyphylla*, *Plagiomnium cuspidatum*, *Leskea gracilescens*.



rough mats, becoming very different in aspect when whetted

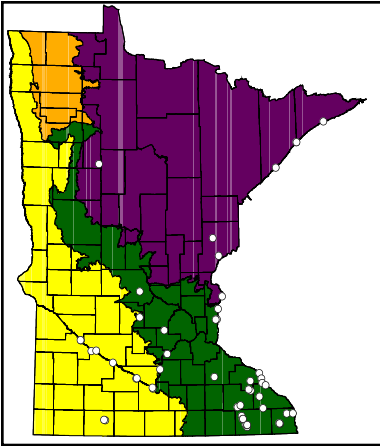
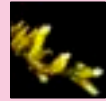


the sporophytes have elongated setae that expose the mature capsules effectively outward from the gametophytic patch



when wet the leaves are somewhat irregular-complanately arranged

ANOMODON ROSTRATUS



Abundance: Frequent (F_{11}).

Habitat and field aspect: Frequent in southern and central mesic hardwood forest, and on southern cliff classes and open talus. Occasional in southern dry-mesic oak woodland. Recorded from northern wet cliff and in wet conifer forest. Commonly found on friable sandstone or other felsic and calcareous rocks, but also on hardwood bark and organic terrestrial substrates. Somewhat **bluish- to light-green rough and bulging mats**, with **upturned branches**, the older ones distinctly yellow-brown, and the patches loosely attached to the substrate.

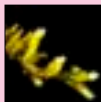
Aid to Identification: The **straight leaves are ovate-lanceolate**, somewhat imbricate but not very altered when dry, **sharply acuminate**, with **costae excurrent as hyaline tips**. The **branching is irregular** and there are **no flagelliform branches**.

Look-Alike Species: Quite a bit smaller and less matte than the other more common Minnesota *Anomodon*

species (*A. attenuatus*, C/F_{17} , and *A. minor*, C_{23}), and with a more distinct saxicolous preference. The smaller (only approximately 1 mm long) and sharply acuminate leaves and excurrent costae also differentiate *A. rostratus* from all other *Anomodon* species. The branches are upturned, not like the more prostrate ones of *Haplodadium microphyllum* (C_{24}), which a more pinnately branched species, usually lignicolous and forming flat mats. *Leskeella nervosa* (F_{107}) grows as scattered stems or small patches among other corticolous bryophytes on hardwood-tree bark) and the rare *Lescuraea saxicola* (R_1 , with stem paraphyllia) are somewhat smaller than *A. rostratus*. Their leaves are narrowly lanceolate and their excurrent tips of the costae aren't obviously hyaline. *Lindbergia brachyptera* (F_{16}) has strongly imbricate leaves when dry that quickly become widely spreading-erect when the plants are wetted. Its leaves are also narrowly lanceolate. The *Leskea* species (*L. gracilescens*, C/F_{157} , and *L. polycarpa*, F/O_{11}), *Eurhynchiastrium pulchellum* (C/F_{19}), and *Oxyrrhynchium hians* (F_8) have blunter, often widely ovate-lanceolate leaves, or even somewhat secund leaves, without excurrent costae. *Brachythecium* species have glossy leaves, usually plicate, with less obvious costae.

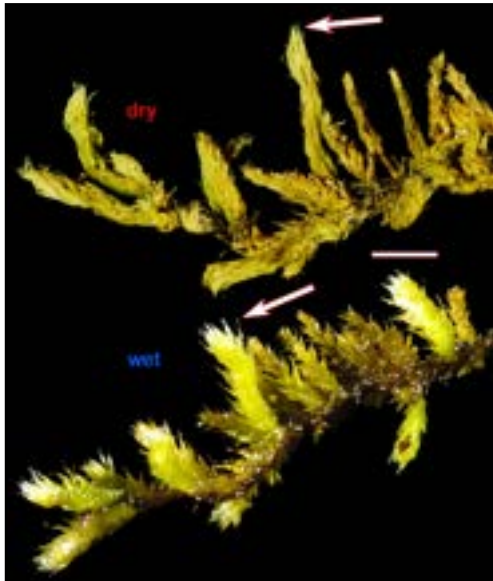


light-green rough and bulging mats, commonly on rocks



ANOMODON ROSTRATUS

Associated Species: Mesohab: *Brachythecium acuminatum*, *Plagiomnium cuspidatum*, *Anomodon attenuatus*, *Anomodon minor*, *Platygyrium repens*, *Hygroamblystegium varium* mod. 'varium', *Taxiphyllum deplanatum*; Microhab: *Callicladium haldanianum*, *Plagiomnium cuspidatum*, *Brachythecium acuminatum*, *Hypnum pallescens*; Pop: *Anomodon attenuatus*, *Brachythecium acuminatum*.

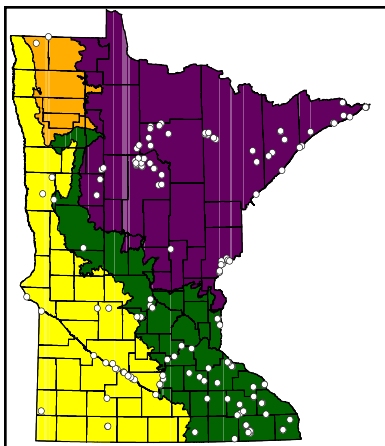


slightly altered dry versus wet; stems with upturned branches;
the hyaline excurrent costae are most easily observed when the plants are wet (white arrows)



stems with upturned branches, densely compacted

BRACHYTHECIUM ACUMINATUM



Abundance: Common (C_{20}).

Habitat and field aspect: Common in all mesic hardwood forest classes throughout the state. Similarly frequent in most fire-dependent forest/woodland classes and on southern cliff and talus classes and on northern wet cliff. Occasional in southern floodplain forest and northern wet forest. Recorded from northern, prairie, and southern wet meadow/carr, southern dry savanna and mesic prairie, clay/mid and rocky river shore, Lake Superior rocky shore, southern bedrock outcrop, and northern alder swamp. The species is most commonly found epixylic and on bark. It has a somewhat weedy or ruderal aspect, and forms often **large, glossy patches** in the more drier and somewhat disturbed microhabitats.

Aid to Identification: **Highly glossy when dry** and colored the characteristic yellow-green of a *Brachythecium s.l.* (it is a large unwieldy genus, lately split up over a

number of additional genera). The **branches can be either straight**, forming a dense smooth mat, tightly adhering to the substrate, **or curved** and large clones with such branches might be nearly weft-forming. The **leaves are appressed to the stem and branches**, both wet and dry. They are usually **distinctly plicate**.

Look-Alike Species: Many other *Brachythecium s.l.* species (C to U) occur in the state—*B. acuminatum* the one most often found in drier microhabitats. It often covers the base of trees and is commonly dusty. Its **terete branches** are the easiest field character state to differentiate it from other similar species. *Brachythecium oxycladon* is similar, but larger, with more widely ovate-lanceolate and less appressed leaves. *Sciurohypnum reflexum* (F_{11}) is also found on bark in many settings, but is smaller and matte, and the costa is percurrent. Actually, most costate non-*Brachythecium s.l.* species in similar habitat have a matte aspect, while *B. acuminatum* is distinctly glossy. *Eurhynchiastrum pulchellum* (C/F₁₉) has erect-spreading leaves, is more matte, and its branch leaves are distinctly different from those of the stem, with short obtuse apices. *Haplocladium microphyllum* (C_{24}) is matte, more pinnately branched, and the stems are paraphyllous.



large clone on hardwood forest floor, somewhat weft-forming; usually the stems and branches are more appressed to the substrate and the clones form smooth mats

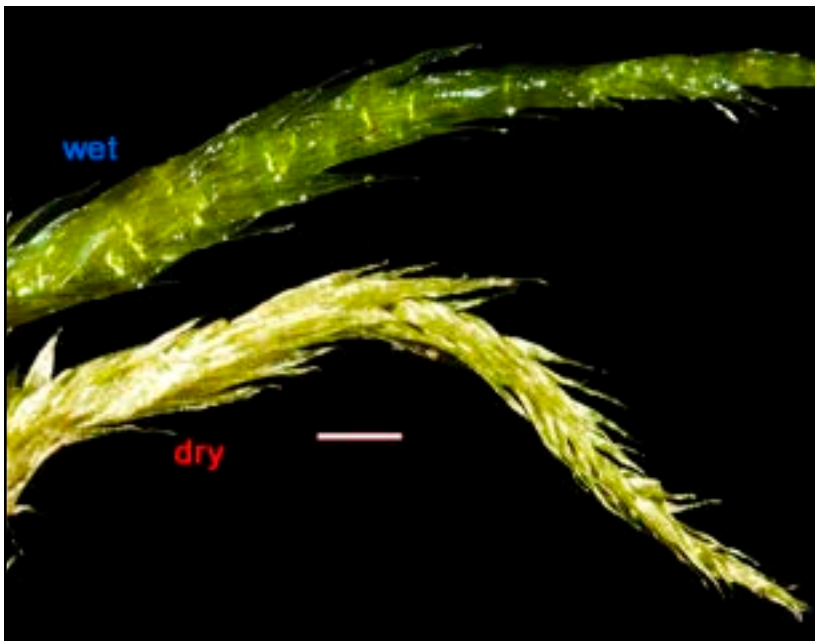


BRACHYTHECIUM ACUMINATUM

Associated Species: Mesohab: *Plagiomnium cuspidatum*, *Platygyrium repens*, *Anomodon minor*, *Hygroamblystegium varium* mod. 'varium'; Microhab: *Callicladium haldanianum*, *Plagiomnium cuspidatum*, *Hypnum pallescens*, *Platygyrium repens*; Pop: *Plagiomnium cuspidatum*, *Haplocladium microphyllum*, *Hygroamblystegium varium* mod. 'varium', *Anomodon attenuatus*, *A. minor*.

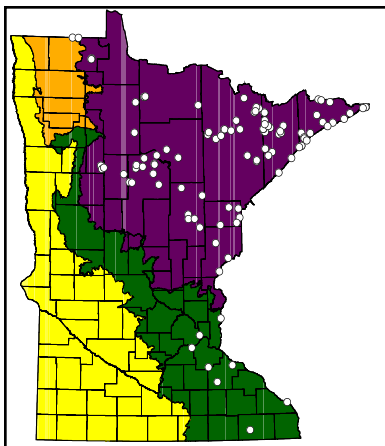
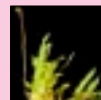


bright yellow-green, terete branches, with the tips often whitened, a common characteristic for the entire genus



both wet and dry the leaves are erect to appressed, distinctly plicate

EURHYNCHIASTRUM PULCHELLUM



Synonym: *Eurhynchium pulchellum*.

Abundance: Common/Frequent (C/F₁₉).

Habitat and field aspect: Common in northern fire-dependent dry to mesic mixed woodland and forest. Frequent in northern mesic hardwood (cedar) forest, and recorded from central oak-aspen forest and northern boreal hardwood-conifer forest. Occasional in northern rich swamps, mainly associated with cedar/fir and black spruce, less so with tamarack and alder; also in southern rich conifer swamp. Found in northern wet ash and conifer forest. Recorded from Lake Superior rocky shore, northern mesic and wet cliff, and northern rich fen and poor conifer swamp. Often encountered on bark at the base of upright tree trunks, but also on coarse woody debris, organic and mineral soil, or rock. The species forms **small patches, somewhat matte, of a bright-green to yellow-green color** among other mat forming bryophytes, usually in a fairly mesic microhabitat. It needs to be studied somewhat closer before it is easily recognized.

Aid to Identification: The **ovate-lanceolate branch**

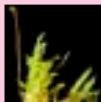
leaves are distinctly **smaller than the stem leaves**, and have short cells in the extreme **apex**, giving it a narrowly **obtus**e aspect (use the 20x handlens). The stem leaves are usually acuminate, less frequently blunt at the apex. The **costae are not excurrent**, but end somewhat before the tip of the apex, even on the largest leaves.

Look-Alike Species: A search image has to be developed to field-identify this species easily, but once you have recognized the abruptly obtuse apices of the branch leaves, even the field aspect of the species becomes quite characteristic. Most of the smaller branches grow upright in the dense mat, producing a turf growth form. When dry *E. pulchellum* is not as glossy, and is usually brighter green than similar common *Brachythecium* species, and its leaves are not as obviously plicate. *Brachythecium rivulare* (C₂₁) has smooth leaves, but typically they are apiculate and the species grows in wetland mesohabitat. *Oxyrrhynchium hians* (F₈), a species restricted to the southern half of the state, is somewhat larger than *E. pulchellum* and has acute branch-leaf apices, but is otherwise of similar aspect. *Rhynchostegium serrulatum* (C/F₁₅) has sharply serrate leaves with a somewhat complanate aspect, and grows in similar mesohabitat as *E. pulchellum*. *Rhynchostegium aquaticum* (O₁) is found on rocks in running water and seepages.

Associated Species: Mesohab: *Callicladium haldanianum*, *Platygyrium repens*, *Plagiomnium cuspidatum*, *Dicranum flagellare*, *Tetraphis pellucida*, *Pleurozium schreberi*, *Ptilidium pulcherrimum*, *Sanionia uncinata*, *Thuidium delicatulum*; Microhab: *Callicladium haldanianum*, *Hypnum pallescens*, *Plagiomnium cuspidatum*, *Platygyrium repens*; Pop: *Sanionia uncinata*, *Brachythecium erythrorrhizon*, *Plagiomnium cuspidatum*.



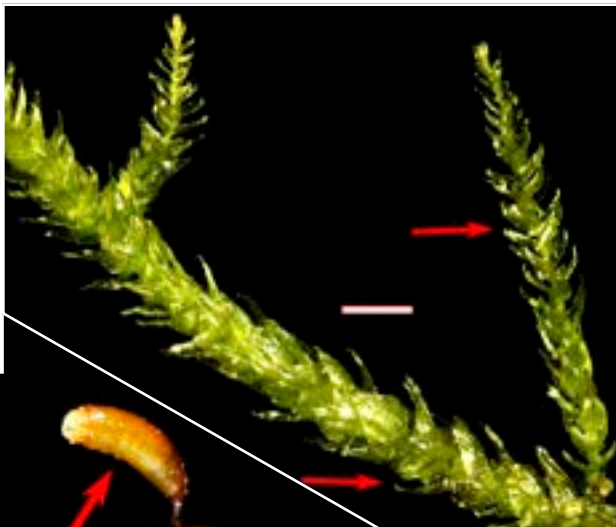
usually forming sizeable clones with upright branches, densely packed, giving the patch a turf-like aspect



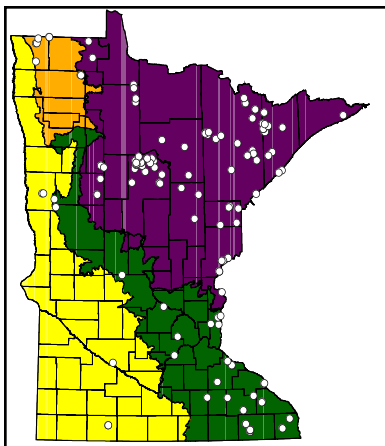
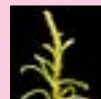
EURHYNCHIASTRUM PULCHELLUM

right: the branches have somewhat crinkly, obtuse apices; the stem leaves are usually acuminate

below: most branches are growing upright; the capsules are typical Hypnales, oblong-cylindrical and curved; the operculum (here fallen off but stuck on a nearby seta of a mature sporophyte) have a long beak or rostrum



HAPLOCLADIUM MICROPHYLLUM



Synonym: *Bryohaplocladium microphyllum*.

Abundance: Common (C₂₁).

Habitat and field aspect: Common in most classes of mesic hardwood forest throughout the state. Frequent in northern and southern floodplain forest, northern and northwestern fire-dependent woodland and mixed forest, and in northern wet forest and meadow/carr. Occasional in northern forested rich peatland and in southern rich conifer swamp, and along river shore. Recorded from southern dry savanna, open talus, and northern rich fen. Usually found on large sections of rotten wood of coarse woody debris, forming **flat, often expansive, rough, matte and mottled-brown mats**. As scattered plants or small patches among other bryophytes on the bark of hardwood trees. Also **highly trampling-resistant**, and found covering mineral substrate on shaded trails.

Aid to Identification: The long, creeping **stems are clearly uni-pinnately branched**, and covered by **sparse, small and greenish paraphyllia**. The **leaves are narrowly ovate-lanceolate, somewhat curved-secund, with percurrent costae**.

Look-Alike Species: *Haplocladium virginianum* (U₄) stems are more compact and more densely paraphyllous, but critical characters have to be studied microscopically. *Haplocladium microphyllum* is also similar to weft-forming forest-floor mosses *Thuidium delicatulum* (C₂₁) and *T. recognitum* (C₂₀), but uni- rather than tri-pinnately branched, and in flatter, more strongly adhering mats. *Abietinella abietina* (F₁₀) is uni-pinnately branched, but most of the stems are growing upright, forming an untidy rough mat, in very dry and often exposed microhabitat. Its leaves are shorter, more widely ovate-lanceolate, and the costae do not reach into the leaf apex. On hardwood bark *H. microphyllum*, growing as scattered plants, might appear similar to *Leskeella nervosa* (F₁₀) or *Lindbergia brachyptera* (F₁₆), but its stems are usually distinctly pinnately branched, and have a sparse cover of paraphyllia that the other species lack. *Leskea* species are irregularly branched, have stubbier leaves, and no paraphyllia, as *Brachythecium* and *Sciuro-hypnum* species, which are often highly glossy.



below: extensive mat extending on rotting wood along fallen tree trunk
above: pinnately branched stem, often brown



HAPLOCLADIUM MICROPHYLLUM

Associated Species: Mesohab: *Plagiomnium cuspidatum*, *Platygyrium repens*, *Anomodon minor*, *Callicladium haldanianum*, *Brachythecium acuminatum*, *Brachythecium salebrosum*, *Hygroamblystegium varium* mod. 'varium', *Entodon cladorrhizans*; Microhab: *Callicladium haldanianum*, *Plagiomnium cuspidatum*, *Hypnum pallescens*, *Platygyrium repens*, *Brachythecium acuminatum*, *Dicranum flagellare*, *Ptilidium pulcherrimum*, *Brachythecium erythrorrhizon*, *Sanionia uncinata*, *Lophocolea heterophylla*, *Dicranum montanum*, *Sciurohypnum reflexum*, *Jamesoniella autumnalis*; Pop: *Plagiomnium cuspidatum*, *Callicladium haldanianum*.



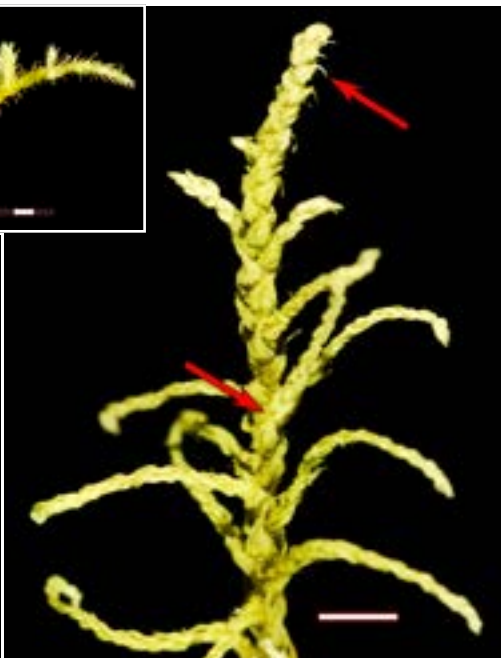
distantly pinnately branched, sharply pointed and elongated stems



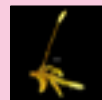
top: stems quite elongated, with interrupted pinnate branching

right: leaves frequently somewhat curved-secund, with percurrent costa

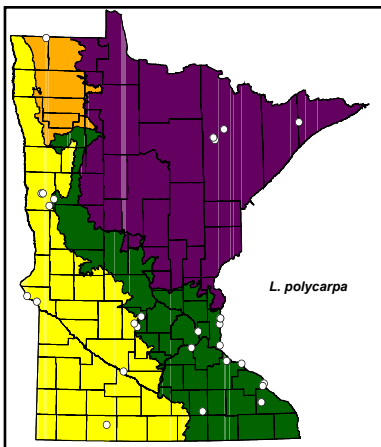
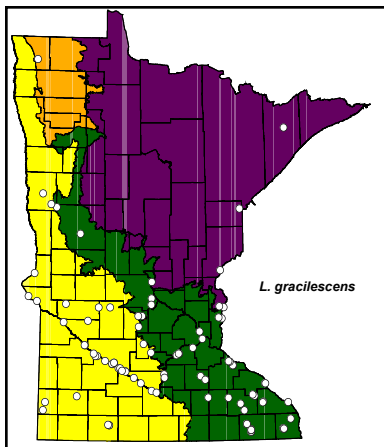
far right: narrow leaf apiculi; when dry the paraphyllia are easier to observe along the main stem



LESKEA GRACILESCENS AND L. POLYCARPA



Abundance: *L. gracilescens*: Common/Frequent (C/F₁₅) and *L. polycarpa*: Frequent/Occasional (F/O₁₁).



Habitat and field aspect: *Leskea gracilescens* is common in southern terrace and floodplain forest, *L. polycarpa* is also found there and in northern terrace forest and northern wet meadow/carr. Both occur in southern and central mesic hardwood forest, southern dry-mesic fire-dependent forest/woodland and rich conifer swamp. *Leskea gracilescens* found in southern seepage meadow/carr, *L. polycarpa* also in northern and prairie wet meadow/carr. *Leskea gracilescens* recorded from southern dry savanna, and open talus; also from clay/mud river shore. Both species are, in my opinion, nearly indistinguishable in the field. They are **small (< 1 mm wide), irregularly to uni-pinnately branched pleurocarps, forming matte mats on hardwood bark, rarely on rock**. When mature sporophytes are present, those of *L. polycarpa* are supposedly curved, but I have never obtain convincingly good material in Minnesota.

Aid to Identification: The **leaves are short ovate-lanceolate**, those of *L. polycarpa* somewhat narrower, and often **curved-secund** at the distal end of branches and stems.

Look-Alike Species: Both species are readily distinguished from an equally frequently found small hardwood corticolous species, *Lindbergia brachyptera* (F₁₆): it has long acuminate apices on leaves which respond to wetting by immediately taking on a erect-spreading angle. *Anomodon minor* (C₂₂) and *A. attenuatus* (C/F₁₇) are larger plants (stem and expanded leaves > 1 mm wide when wet), and have a somewhat complanate aspect. *Anomodon rostratus* (F₁₁) and *Haplocladium microphyllum* (C₂₄) also have long acuminate, even hyaline apices or excurrent costae; the former is usually found on cliffs, the latter on many different substrates, and usually distinctly pinnately branched. Other small corticolous species are usually somewhat more glossy (longer, narrower cells), and need to be differentiated with the microscope (many are ecostate).



most typically growing high up on tree trunks,
but also exceptionally on rock

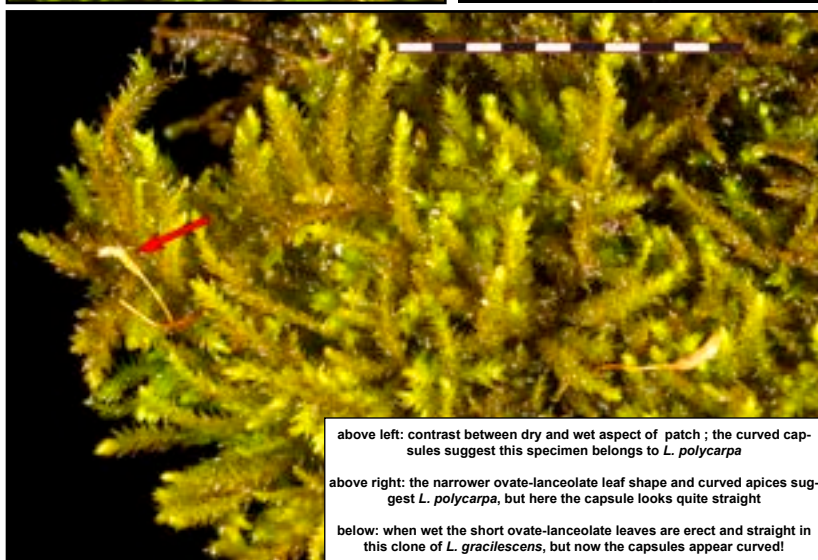
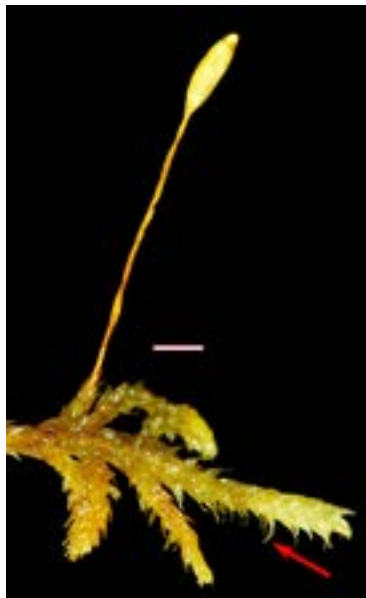




LESKEA GRACILESCENS AND *L. POLYCARPA*

Associated Species: for *L. gracilescens*: Mesohab: *Plagiomnium cuspidatum*, *Platygyrium repens*, *Brachythecium acuminatum*, *Anomodon minor*; Microhab: *Callicladium haldanianum*, *Platygyrium repens*, *Hypnum pallescens*, *Plagiomnium cuspidatum*; Pop: *Brachythecium acuminatum*, *Platygyrium repens*, *Anomodon minor*.

for *L. polycarpa*: Mesohab: *Plagiomnium cuspidatum*, *Hygroamblystegium varium* mod. 'varium', *Anomodon minor*, *Leskea gracilescens*; Microhab: *Platygyrium repens*, *Callicladium haldanianum*, *Hypnum pallescens*, *Plagiomnium cuspidatum*; Pop: *Orthotrichum pumilum*, *Brachythecium acuminatum*, *Anomodon minor*, *Platygyrium repens*, *Orthotrichum obtusifolium*.

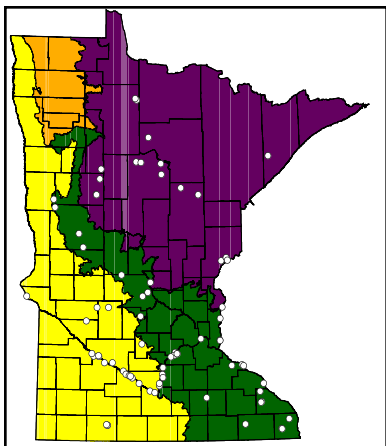


above left: contrast between dry and wet aspect of patch ; the curved capsules suggest this specimen belongs to *L. polycarpa*

above right: the narrower ovate-lanceolate leaf shape and curved apices suggest *L. polycarpa*, but here the capsule looks quite straight

below: when wet the short ovate-lanceolate leaves are erect and straight in this clone of *L. gracilescens*, but now the capsules appear curved!

LINDBERGIA BRACHYPTERA



Abundance: Frequent (F_{16}).

Habitat and field aspect: Frequent in southern mesic maple-basswood forest. Occasional in other mesic hardwood forest throughout the state, in northern wet conifer forest and ash swamp, and in southern fire-dependent forest/woodland and floodplain forest. Recorded from northern terrace forest, southern rich conifer swamp, and clay/mud river shore. Most frequently found as **scattered plants or small patches on hardwood bark** among other corticolous bryophytes.

Aid to Identification: **When wetted**, the plants change dramatically in appearance, as the leaves, first tightly appressed, **suddenly become erect-spreading to even squarrose**. The leaf acumen is narrowly acuminate, and somewhat hyaline, but the costa is not percurrent. Sometime **clusters of brood branches** (propagula) are found in the upper leaf axes.

Look-Alike Species: A number of similar shrivelled (when dry) and small matte pleurocarp species occur in the same microhabitat, often intricately mixed together, but only *L. brachyptera* displays the sudden

quick change from a inconspicuous dry to expanded wet appearance. *Leskeella nervosa* (F_{10}) has a more percurrent costa. The leaves of the *Leskea* species, *L. gracilescens* (C/F_{15}) and *L. polycarpa* (F/O_{11}), are more widely ovate-lanceolate, often with a somewhat blunt, sometimes secund, acumen. The *Anomodon* species, *A. attenuatus* (C/F_{17}) and *A. minor* (C_{22}), are much larger and, when wetted, have a complanate aspect. *Haplcladium microphyllum* (C_{24}) is usually distinctly pinnately branched. *Brachythecium acuminatum* (C_{20}) is highly glossy. Similarly some other epicorticolous, but ecostate, species are quite glossy, such as *Pylaisia polyantha* (C/F_{20}), *P. selwynii* (F_{21}), and *Platygyrium repens* (C_{25}). They also have a different branching pattern, with many upturned terminal branches.

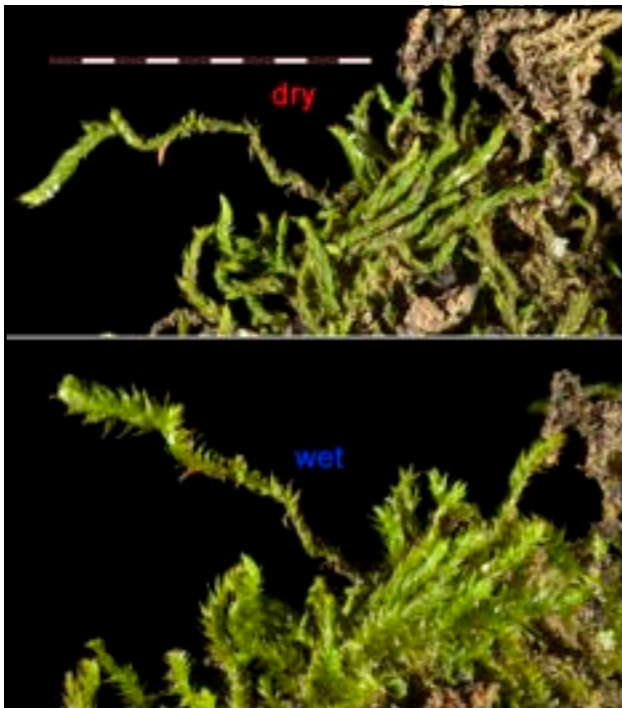


growing as small patches or scattered plants on hardwood bark



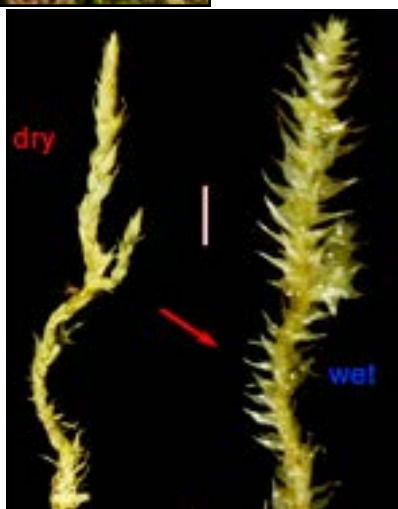
LINDBERGIA BRACHYPTERA

Associated Species: Mesohab: *Anomodon minor*, *Plagiomnium cuspidatum*, *Platygyrium repens*, *Entodon cladorrhizans*, *Haplocladium microphyllum*, *Brachythecium acuminatum*, *Hygroamblystegium varium* mod. 'varium'; Microhab: *Callicladium haldanianum*, *Platygyrium repens*, *Hypnum pallescens*, *Plagiomnium cuspidatum*, *Ptilidium pulcherrimum*, *Dicranum flagellare*, *Brachythecium acuminatum*; Pop: *Frullania ebora-censis*, *Platygyrium repens*, *Anomodon minor*, *Orthotrichum pumilum*, *Leskea gracilescens*, *Pylaisia selwynii*, *Orthotrichum obtusifolium*, *Frullania bolanderi*.



above: when dry the leaves are mostly tightly appressed or imbricate; they become erect-spreading very quickly when the plants are wetted

right: the leaves are matte because of the papillose cell type: these papillae are responsible for the rapid spread of the water film over the entire plant





ECOSTATE PLEUROCARPS ON PEAT

CALLIERGONELLA CUSPIDATA



Abundance: Frequent (F₂₀).

Habitat and field aspect: Frequent in northern and prairie open rich peatland (a near obligate calcareous fen indicator in Minnesota), and in northern and southern wet meadow/carr. Occasional in patterned northern spruce and tamarack swamp, and in southern conifer swamp. Recorded from northern alder swamp. Usually, in Minnesota, forming **clones under heavy thatch** in graminoid wet meadows and calcareous fens.

Aid to Identification: The **stem and branches are flattened**, still turgid looking, but with **somewhat complanate leaves, tightly enrolled at the tips of the branches**. The **branching** is distinctly **pinnate**. **Large, abruptly differentiated alar-cell groups** are visible at the leaf insertion with a 20x handlens.

Look-Alike Species: **The complete absence of a costa and complanate aspect** distinguish this species from *Calliergon* species, even those with inflated alar cells, such as *Calliergon cordifolium* (C₁₇) and *Calliergon giganteum* (F₁₃). *Pseudocalliergon turgescens* (O/U₃) is a nearly unbranched plant, with tightly appressed leaves. The branches of *P. turgescens* are perfectly terete, not flattened as those of *C. cuspidata*. *Pleurozium schreberi*, an common (C₁₃) but usually a more mesic forest-floor species, has a superficial similarity, with its reddish stem visible through the leaves when wet, but its leaves are abruptly apiculate, while those of *C. cuspidata* are roundly obtuse. Neither do they form the cuspidate enrolled tips characteristic of *Calliergonella cuspidata*. *Entodon*



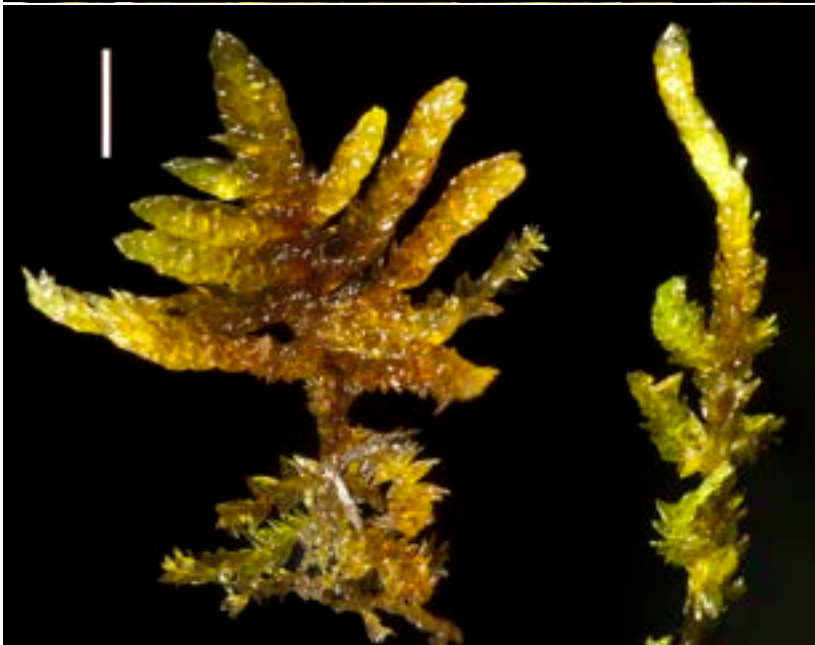
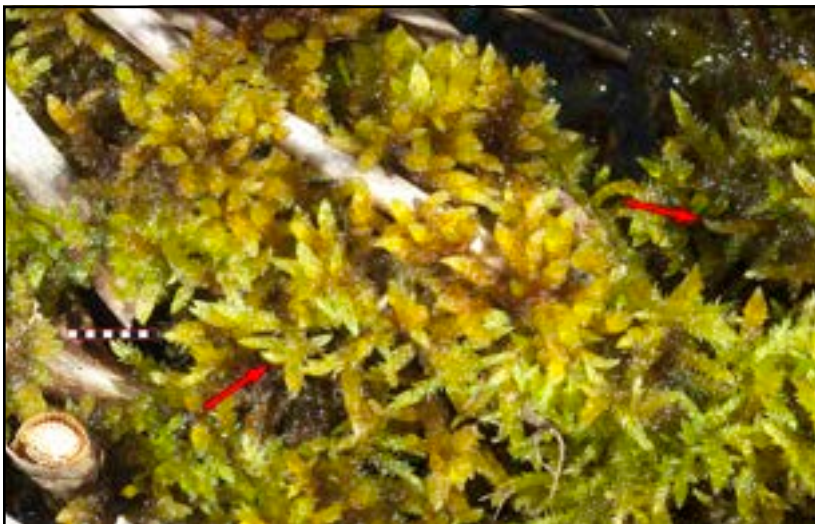
bottom: usually forming small clones
top: stems and branches with bluntly pointed tips



CALLIERGONELLA CUSPIDATA

cladorrhizans (C/F₂₀) and *E. compressus* (U₂) are glossy plants growing on wood, with much more strongly complanate shoots. Their stems are not reddish, and the leaf tips acute to shortly apiculate. The alar cells are only moderately differentiated.

Associated Species: MesoHab: *Ptychostomum pseudotriquetrum*, *Campylium stellatum*, *Drepanocladus aduncus*, *Plagiomnium ellipticum*, and *Aneura pinguis*; Pop: *Campylium stellatum*, *Drepanocladus aduncus*, *Ptychostomum pseudotriquetrum*, *Scorpidium cossonii*, and *Plagiomnium ellipticum*.



top and below left: turgid shoots with pinnate branching and tightly enrolled leaves at the tip of the stem and branches
bottom right: in profile the complanate aspect of the leaves is obvious

CAMPYLIUM STELLATUM



Abundance: Common (C_{21}).

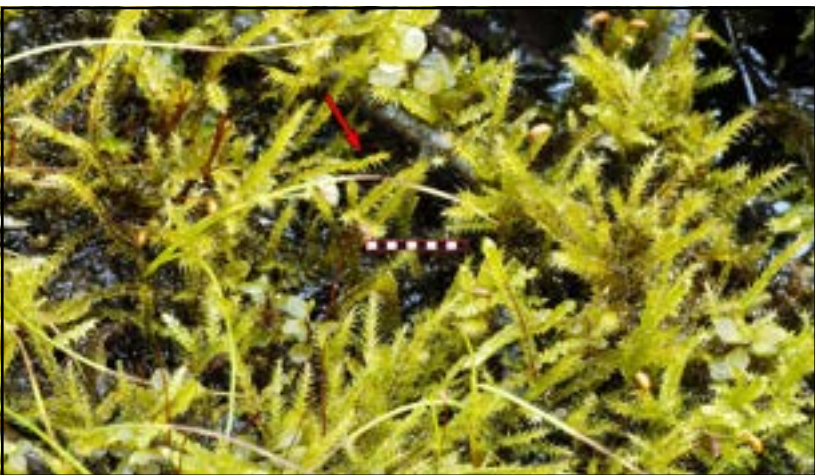
Habitat and field aspect: Common in open rich peatland, such as northern and prairie extreme rich fen (an excellent near-obligate calcareous fen indicator in Minnesota) and prairie and northern (mainly water track) rich fen. Occasional in northern and northwestern forested rich peatland (all classes, but mainly in patterned northern rich spruce and tamarack swamp). Encountered in the wet meadow/carr system of every region (northern, prairie, and southern). Found in wet conifer and wet ash forest, and in a northern transitional fen. The species is usually growing somewhat elevated above the water table, forming **small hummocks or larger carpets on microtopographic highs**, such as strings in patterned rich fen. Its **stiff aspect and glossy yellow to bright golden color** without reddish or brown pigment makes it easy to locate. In calcareous fen the plants often have a crusty feel to them because of carbonate precipitate surrounding the old stems.

Aid to Identification: The branches, when seen from above, have a **stellate (star-shaped) appearance**. The

leaves, typically at least 2 mm long, are **stiffly spreading to erect-spreading**, and **straight**, with a very sharp looking upper half (with concave sides, forming a gradually **narrowed tubulose apex**). Most leaves have **no costa, some a double one with unequal prongs**. Sometimes the leaves are surprisingly curved-secund.

Look-Alike Species: Most closely related to the similar-sized *Drepanocladus polygamum* ($F_{C_{19}}$), also a near-obligate calcareous fen indicator. Its major field distinction is the presence of a single costa. Other related species, such as *C. protensum* (O/U_7 , possibly a *C. stellatum* modification), *Pseudocampylium radicale* ($F_{18'}$, with a weak single costa and decurrent leaves), and *Campyliadelphus chrysophyllus* ($F_{16'}$, with a single costa, and the leaves often curved-secund at the tip of the branches), are smaller plants, with narrower leaves, but hard to differentiate in the field from small and depauperate *C. stellatum* when it is growing under dense thatch: microscopic evaluation is necessary. Another approximate look-alike of both *Campylium stellatum* and *C. (D.) polygamum* is *Tomentypnum nitens* (F_{11}). This calcareous fen indicator grows in similar mesohabitat, in the same microtopographic locations. However, it should be easily differentiated with its sharply lanceolate, rather than tubulose, and distinctly plicate leaves, and by its abundant brown stem tomentum.

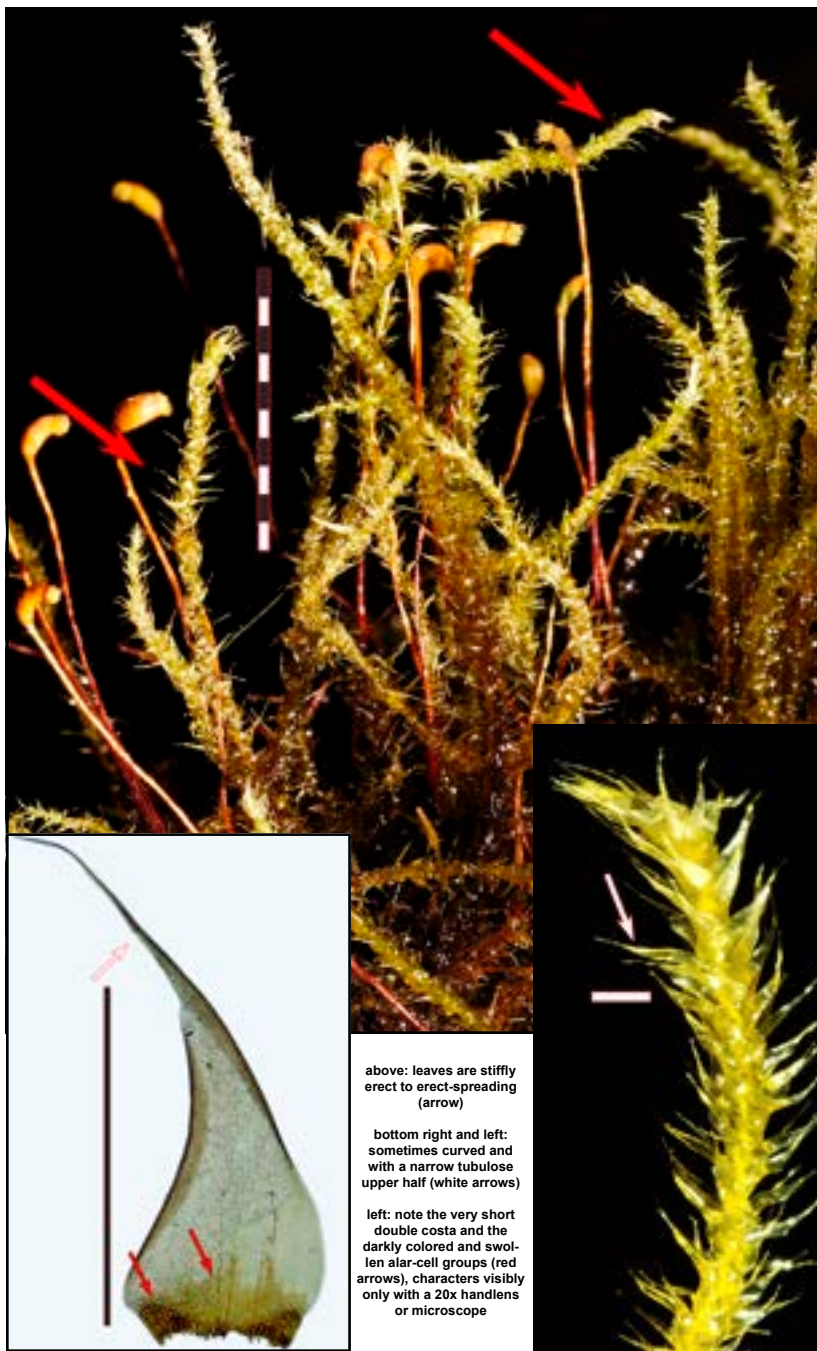
Associated Species: MesoHab: *Ptychostomum pseudotriquetrum*, *Drepanocladus aduncus*, *Scorpidium cossonii*, *Plagiomnium ellipticum*, and *Aulacomnium palustre*; Pop: *Ptychostomum pseudotriquetrum*, *Scorpidium cossonii*, *Aneura pinguis*, *Drepanocladus aduncus*, and *Calliergonella cuspidata*.



typical stiff aspect of the yellow branches of *C. stellatum*; note the few scattered plants of *Scorpidium cossonii* among them, with the brown rather than yellow stem and the circinate leaves; the leaves are often somewhat curved-secund (arrow)



CAMPYLUM STELLATUM

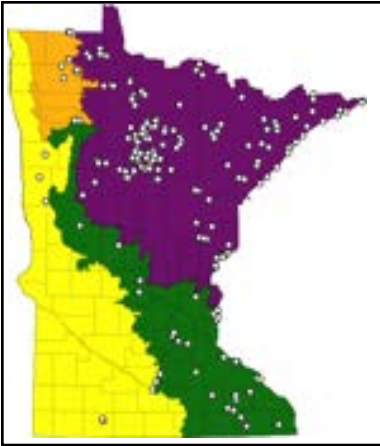


above: leaves are stiffly erect to erect-spreading (arrow)

bottom right and left: sometimes curved and with a narrow tubulose upper half (white arrows)

left: note the very short double costa and the darkly colored and swollen alar-cell groups (red arrows), characters visibly only with a 20x handlens or microscope

HYPNUM LINDBERGII

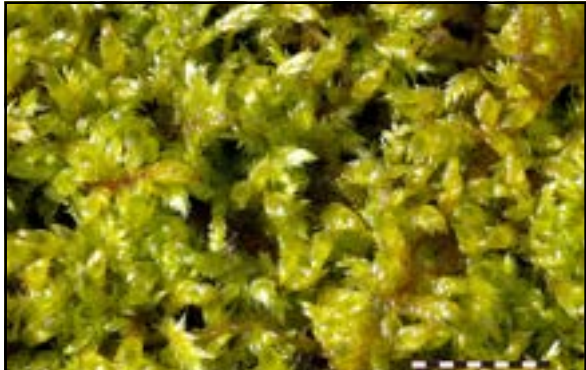


Abundance: Common (C₂₃).

Habitat and field aspect: Common in northern and northwestern forested rich peatland, mostly in rich spruce and tamarack swamp, less so in cedar/fir swamp. Frequent in northern very wet and wet ash and conifer forest. Occasional in northern and southern wet meadow/carr, northern and prairie rich and extreme rich fen, northern and southern floodplain forest, and along rocky and clay/mud river shore. Recorded from Lake Superior rocky shore, northern wet cliff and southern mesic and moderate cliff and open talus, in northern and central mesic hardwood forest, in northern poor conifer swamp and transitional fen, and in northern mesic mixed forest and woodland. Usually found as **small clones under dense thatch**, also frequently as **scattered stems** among other minerotrophic bryophyte species.

Aid to Identification: The **curved to nearly falcate leaves are ecostate**, and usually **distinctly second rather than complanate**. With the 20x handlens it might be possible to discern the **small groups of inflated alar cells** at the leaf insertions.

Look-Alike Species: *Hypnum pratense* (C₂₀) is the most closely related species in wetland habitat, usually, but not always, possible to differentiate in the field by its leaves curved downward in both a left and right row (complanate), rather than the second tendency apparent in *H. lindbergii* (the species co-occur in 27% of comprehensive ecotopes). Its alar cells do not form small, inflated groups. *Drepanocladus aduncus* (C₂₃) and *D. sordidus* (O₅) with curved or



bottom: often growing on organic debris
top: with turgid branches and curved-to-falcate-second leaves



HYPNUM LINDBERGII

falcate leaves are very similar in the field as *H. lindbergii*, but more with an untidy aspect, and their leaves are costate. Their alar cells are in larger and in more obvious groups, and in the former often reaching the base of the costa. Both *Hypnum* species are green to yellow-green and highly glossy, in contrast to the reddish- or golden-brown *Scorpidium cossonii* (F₁₃¹ with strongly falcate to circinate and costate leaves), *S. scorpioides* (F₈¹ falcate with large and widely ovate-lanceolate ecostate leaves without differentiated alar-cell groups, and *Pseudocalliergon turgescens* (O/U₁, similar but more straight-leaved). Other rich-fen species, previously within the genus *Drepanocladus*, might also have a similar field aspect as *H. lindbergii*: however all the species that occur in Minnesota are distinctly costate. Other *Hypnum* species (ecostate) except for *H. pratense* are usually found in upland mesohabitat or dry microhabitat, and are smaller or more regularly pinnately branched. The most common one is *H. pallescens* (C₁₈).

Associated Species: MesoHabit: *Plagiomnium ellipticum*, *Climacium dendroides*, *Plagiomnium cuspidatum*, *Callicladium haldanianum*, and *Drepanocladus aduncus*; Microhab: *Plagiomnium cuspidatum*, *Hypnum pallescens*, *Platygyrium repens*, and *Brachythecium acuminatum*; Pop: *Plagiomnium ellipticum*, *Ptychostomum pseudotriquetrum*, *Climacium dendroides*, *Campyllum stellatum*, and *Brachythecium salebrosum*.



top left: in deep shade plants with a more etiolated aspect; top right: the leaves clearly ecostate and curving downward
bottom: curved- to falcate-second, rather than complanate leaves, the younger ones tightly enrolled in the more turgid form

HYPNUM PRATENSE

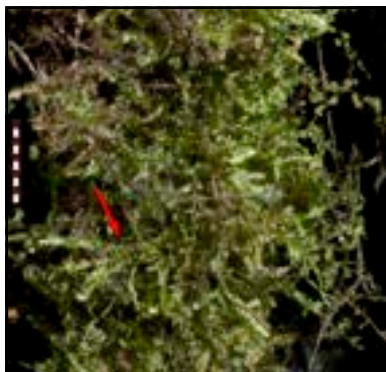


Abundance: Common (C₂₀).

Habitat and field aspect: Common in forested rich peatland such as northern alder, spruce, and tamarack swamp, and southern rich conifer swamp, less so in northern cedar/fir swamp. Frequent in northern and southern meadow/car, and in northern wet and very wet ash swamp. Occasional in open rich peatland classes such as northern rich-fen water track and shrub shore fen, and in prairie extreme rich fen. Recorded from prairie wet meadow/carr; northern wet conifer forest; northern rich and extreme rich fen; northern spruce bog, poor conifer swamp, and transitional fen; northern mesic mixed forest; and central mesic hardwood forest. Usually found in **small patches under dense thatch**, close to the local water table, often with a **strong algal odor**.

Aid to Identification: Typically the **ecostate leaves are complanate in two rows along the sparingly branched stems, and the are curved to falcate, pointing downward to the substrate. No swollen alar cells groups** can be made out with the 20x handlens.

Look-Alike Species: *Hypnum lindbergii* (C₂₃) is its most common congener and co-occurring in 27% of comprehensive ecotopes. Its leaves are curved- to falcate-secund rather than complanate. Its alar cells form small, inflated groups. No other ecostate peatland pleurocarps have the combination of complanate curved leaves and the green color of *H. pratense*. Wetland species with complanate leaves are *Plagiothecium denticulatum* (C₁₉) of similar size and the much smaller *P. laetum* (F₁₃) and *Taxiphyllum deplanatum* (F₈), but their leaves are straight. The strong algal smell of *H. pratense* appears to be quite characteristic, most likely caused by the diatom encrustation as the patches grow so close to the local water table. However, this odor is less likely to occur associated with other species in the same microhabitat. Other related species are usually found in upland mesohabitat or dry microhabitat. The most com-



bottom: pure patch under dense graminoid thatch
top: scattered stems in a deep depression in swamp forest



HYPNUM PRATENSE

mon one is *Hypnum pallescens* (C₁₈⁺, leaves more falcate, plants smaller and pinnately branched); *Platygyrium repens* (C₂₅⁺, with brood branches); *Callicladium haldanianum* (C₂₂⁺, with upturned leaves)

Associated Species:

MesoHab: *Plagiomnium ellipticum*, *Hypnum lindbergii*, *Brachythecium salebrosum*, *Aulacomnium palustre*, and *Climacium dendroides*; Pop: *Plagiomnium ellipticum*, *Brachythecium salebrosum*, *Aulacomnium palustre*, and *Ptychostomum pseudotriquetrum*.



characteristic highly glossy yellow-green color



top: the leaves are complanate, downcurved distinctly in two separate rows; branching is sparse and irregular
bottom: no costae nor groups of inflated alar cells are evident; don't confuse edge of underlying leaf for a costa

SCORPIDIUM SCORPIOIDES



Abundance: Frequent (F₈).

Habitat and field aspect: Frequent in northern and prairie open rich and extreme rich fen, an near-obligate calcareous fen indicator species for Minnesota. Also recorded from northern rich spruce swamp and southern seepage meadow/carr. Two distinct modifications can be found in the field: clones **submerged in marl pool** in calcareous fens consisting of **very large, nearly black and poorly branched plants**; and a more compact and dense growth form of **turgid, but golden- or coppery-brown plants along the edges of pools in rich fens**. Rarely, under dense thatch, such a growth form **might be green**.

Aid to Identification: The **leaves are concave and distinctly imbricate and curved-secund near the tip of the stem and branches**. These tips are also clearly curved. The **leaves have no costae**, and there are **no obviously expanded alar-cell groups** visible with the 20x handlens.

Look-Alike Species: Among other calcareous-fen indicators *Scorpidium cossonii* (F₁₃) is similar. It is more

frequently found than *S. scorpioides* – more common in the forested spring fens – but also grows in small lawns along the edge of rich-fen pools (co-occurring with *S. scorpioides* in 40 % of the ecotopes studied). The individual plants of *Scorpidium scorpioides* are larger and somewhat more turgid, and the absence of the costa is the most critical character state to differentiated it from *S. cossonii*. The leaves are also far less falcate-secund than those of *S. cossonii*. Another calcareous fen species, *Pseudocalliergon turgescens* (O/U₂), has no curved or falcate tendency to its ecostate leaves at all, but is otherwise very similar to *S. scorpioides*. It should not be confused with *Pseudocalliergon trifarium* (F₂), another extreme rich-fen



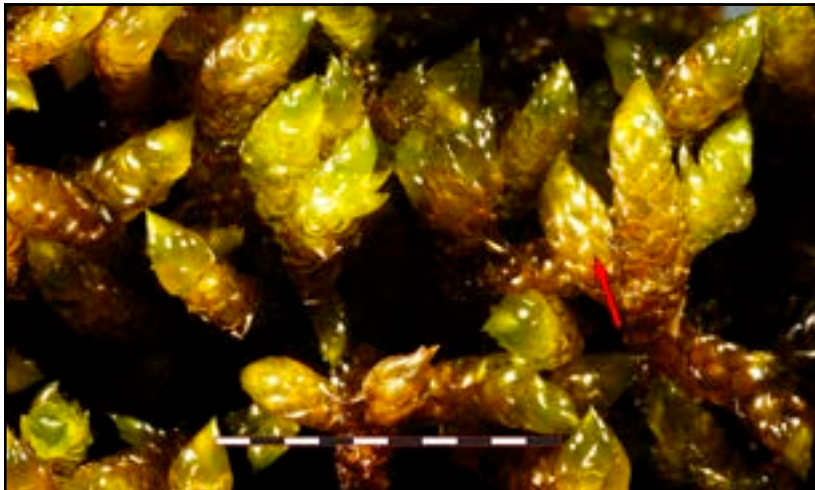
bottom: more characteristic color of a lawn-forming population at the edge of rich-fen pool
top: rarely green when growing under dense thatch



SCORPIDIUM SCORPIOIDES

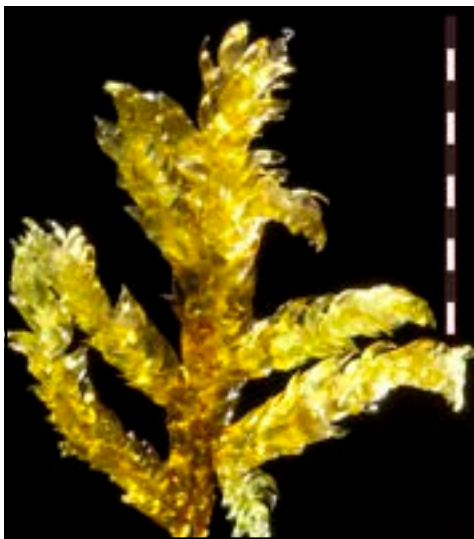
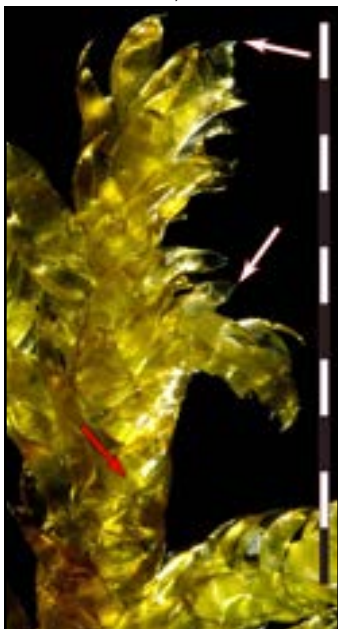
species with strongly imbricate leaves and turgid branches. Its leafy stems are much narrower than either *S. scorpioides* and *S. turgescens*, and its leaves are costate. *Entodon seductrix* (F/O₃₁) is usually an upland species growing on wood, and light-green and glossy, with straight, widely ovate and ecostate leaves with a short acute apex.

Associated Species: MesoHab and Pop: *Campylium stellatum*, *Scorpidium cossonii*, *Ptychostomum pseudotriquetrum*, and *Pseudocalliergon trifarium*.



turgid plants with somewhat curved-secund branch tips formed by enrolled leaves

right: irregularly or sub-pinnately branched plants with strongly imbricate and deeply concave, ecostate leaves

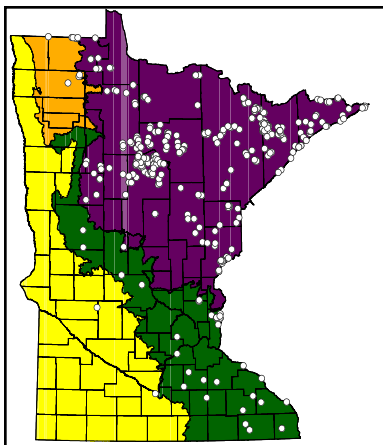


left: leaves with a small apiculus (white arrows), deeply concave and ecostate (red arrow)



ECOSTATE PLEUROCARPS ON BARK, WOOD, ROCK

CALLICLADIUM HALDANIANUM

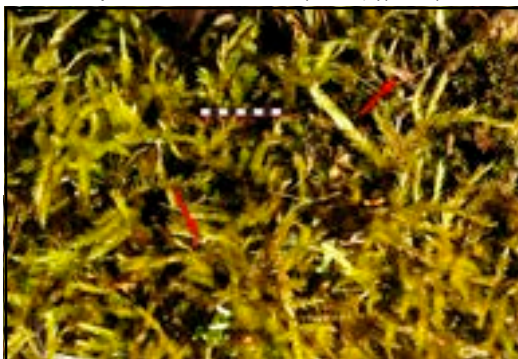


Abundance: Common (C₂₂).

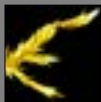
Habitat and field aspect: Common in northern poor conifer swamp of the acid peatland, in northern mesic mixed forest of the fire-dependent forest, and in northern rich tamarack, rich spruce, and alder swamp of the forested rich peatland systems. Frequent in mesic hardwood forest, and in wet forest associated with black ash in all regions. Occasional in more open mesohabitat, such as northern rich and extreme rich fen, wet meadow/carr, and shrub shore fen, on southern terrace floodplain forest, southern wet and mesic cliff, in seepage meadow, and on northern wet cliff. Recorded from northern mixed cattail marsh, Lake Superior rocky shore, and river shore. *Callicladium haldanianum* is our second most abundant non-*Sphagnum* moss in Minnesota, after *Pleurozium schreberi*. Nearly always found at the base of tree trunks in mesic mesohabitat, but also extremely common on coarse woody debris. Frequently growing on terrestrial substrates: on humus and rocks, somewhat less on litter and sand. **Untidy mats, frequently with sporophytes**, but quite non-descript.

Aid to Identification: Branch leaves are **diagnostically upturned and complanate, smooth**, only **slightly secund**, and showing clearly their **long-acuminate apices**.

Look-Alike Species: Related ecostate species (*Hypnum pallescens* (C₁₈), *Platygyrium repens* (C₂₅), *Ptilium crista-castrensis* (C₁₄), and *Pylaisia selwynii* (F₁₁)) have either straight or down-curved, more distinctly falcate leaves, are pinnately branched, or occur in wet mesohabitat (*Hypnum lindbergii* (C₂₃) and *H. pratense* (C₂₀)). The *Hypnum* species have shorter and more strongly curved capsules.

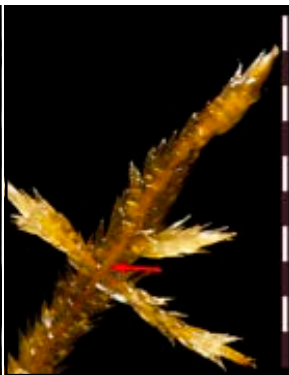
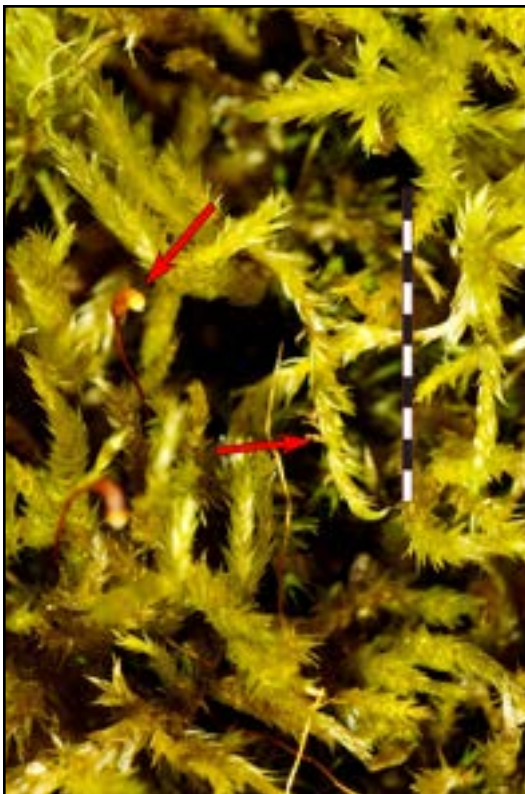


below: untidy mats with upturned leaves, on bark at the base of trees, on rotten wood and litter
above: commonly with sporophytes



CALLICLADIUM HALDANIANUM

Associated Species: Mesohab: *Pleurozium schreberi*, *Aulacomnium palustre*, *Ptilidium pulcherrimum*, *Platygyrium repens*; Microhab: *Plagiomnium cuspidatum*, *Hypnum pallescens*, *Platygyrium repens*, *Brachythecium acuminatum*, *Dicranum flagellare*, *Ptilidium pulcherrimum*, *Brachythecium erythrorrhizon*, *Sanionia uncinata*; Pop: *Dicranum flagellare*, *Sanionia uncinata*, *Hypnum pallescens*, *Ptilidium pulcherrimum*.



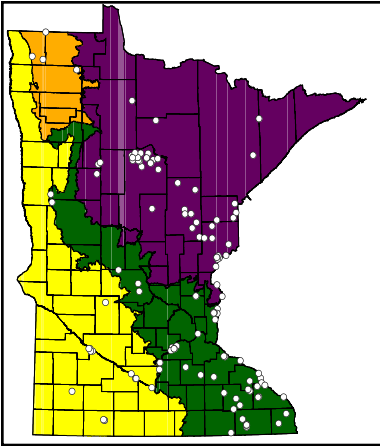
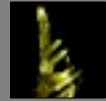
above: leaves transparent when wet left:

left: complanate branches with upturned, slightly curved-second and complanate leaves; capsules long and narrow, curved

below: plant highly glossy when dry with turned-up leaves and branch tips



ENTODON CLADORRHIZANS



Abundance: Common/Frequent (C/F₂₀).

Habitat and field aspect: Common in southern and central hardwood forest. Frequent in southern terrace and floodplain forest, and northern and northwestern wet forest. Occasional in fire-dependent forest throughout the state except for the northwest. Recorded from northern and southern meadow/carr and forested rich peatland. Found on northern dry cliff and rocky river shore. Usually growing on bare wood of fallen logs and tree trunks in mesic and shaded microhabitat, rarely on organic or mineral terrestrial substrates. The **flattened, somewhat pinnately branched stems form a glossy, smooth mat.**

Aid to Identification: The **smooth leaves are tightly imbricate and complanate, with short, acute apices. The capsules of the sporophytes are narrowly cylindric and erect.**

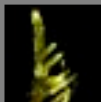
Look-Alike Species: *Callicladium haldanianum* (C₂₂) has a similar glossy and complanate aspect, but its leaves are narrowly acuminate, and curve distinctly upwards.

Its sporophytes have also narrowly cylindric capsules, but they are distinctly curved. Two other glossy species have a flattened, complanate-leaved stem, the most similar one is the congener *E. compressus* (U₂). This species is, however, far more rare in Minnesota, and its stems appear even more flattened. Critical diagnostic characters to differentiate it from *E. cladorrhizans*, however, are microscopic, based on the peristome. *Calliergonella cuspidata* (F₂₀), somewhat flattened, is also an ecostate species, but occurs in wetlands, growing on peat. Its leaves are obtuse, and forming sharp enrolled points at the tip of stem and branches. Another congener, *E. seductrix* (F/O₁₁), is only slightly flattened at best, otherwise very similar in aspect to *E. cladorrhizans*. *Pleurozium schreberi* (C₁₅) is also glossy, sometimes sub-pinnately branched, and growing in similar mesohabitat, but its branches are distinctly terete (not flattened, leaves not complanate), and the leaves quite obtuse with a small, recurved apiculus.

Associated Species: Mesohab: *Plagiomnium cuspidatum*, *Platygyrium repens*, *Anomodon minor*, *Haplocladium microphyllum*; Microhab: *Callicladium haldanianum*, *Plagiomnium cuspidatum*, *Platygyrium repens*, *Hypnum pallescens*; Pop: *Plagiomnium cuspidatum*, *Brachythecium acuminatum*, *Haplocladium microphyllum*, *Platygyrium repens*.



smooth mats on coarse woody debris in mesic hardwood forest



ENTODON CLADORRHIZANS



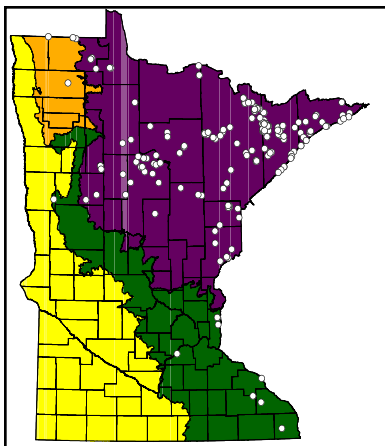
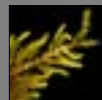
above and left: glossy, distinctly flattened (complanate) stems and branches, often prolifically producing sporophytes with erect, narrowly cylindrical capsules (arrow)

below left: the complanately-oriented acute (arrow) leaves are imbricate and compressed along nearly the entire branch or stem, mostly straight or slightly curving downward

below right: top and profile view of a single gametophore with mature (to the right) and young immature sporophytes (arrows)



HYPNUM PALLESCENS



Abundance: Common (C_{18}).

Habitat and field aspect: Common in northern and central fire-dependent forest and woodland, mostly in northern mesic mixed forest. Frequent in poor conifer swamp and spruce bog in acid peatland. Occasional in northern mesic hardwood forest with some cedar; in northern and northwestern forested rich peatland, usually associated with cedar/fir and black spruce, less with alder and tamarack. Found in northern wet forest, associated both with ash and conifer. Recorded from northern rich fen. The species forms **tightly adhering and smooth, somewhat glossy mats** on bark, both at the base of upright trunks and on coarse woody debris. Also common on rotten wood, somewhat less on stumps and rocks. Found on litter, humus, and sand.

Aid to Identification: The plants are often **quite pinnately branched**, and the **color is variegated green to golden-green to brown**. The **branch leaves are strongly falcate-secund** to circinate, the apices pointing downward. The **capsules are strongly curved**.

Look-Alike Species: *Hypnum pallescens* is more distinctly pinnately branched than the larger *Callicladium haldanianum* (C_{22}), and its leaves more strongly falcate, curving downward rather than upward. It is differentiated from other upland *Hypnum* species (O-U) by the narrowly revolute leaf margins, but these are hard to see, even with the 20x handlens. *Hypnum lindbergii* (C_{23}) and *H. pratense* (C_{20}) are peat-growing species in wetlands. The most similar look-alike is *Platygyrium repens* (C_{25}), growing in variegated golden to green patches, but its leaves are less falcate, and its capsules are erect. Most characteristic are its propogula, which never occur in *H. pallescens*.

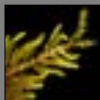
Associated Species: Mesohab: *Callicladium haldanianum*, *Ptilidium pulcherrimum*, *Pleurozium schreberi*, *Dicranum flagellare*, *Platygyrium repens*; Microhab: *Callicladium haldanianum*, *Plagiommium cuspidatum*, *Platygyrium repens*, *Brachythecium acuminatum*, *Ptilidium pulcherrimum*, *Dicranum flagellare*, *Sanionia uncinata*; Pop: *Ptilidium pulcherrimum*, *Callicladium haldanianum*, *Dicranum flagellare*, *Sanionia uncinata*.



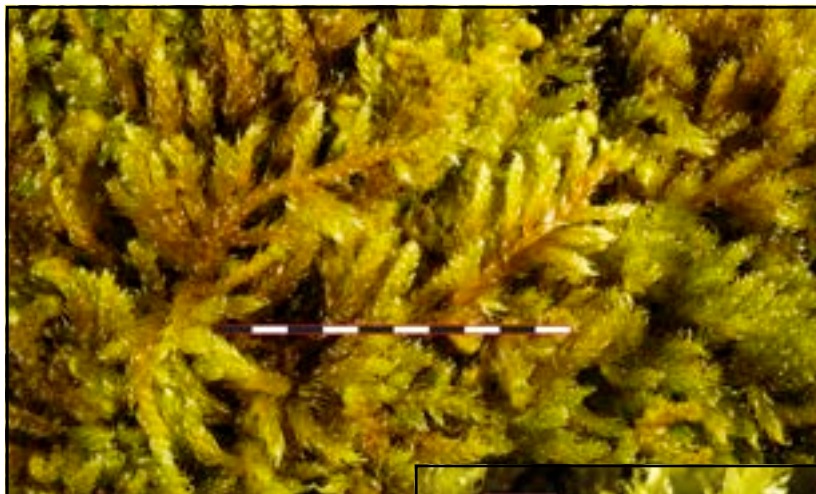
top: plants pinnately branched and leaves strongly falcate-secund



right: variegated green-golden, strongly adhering smooth mat expanding and colonizing (arrow) the base of a tree trunk

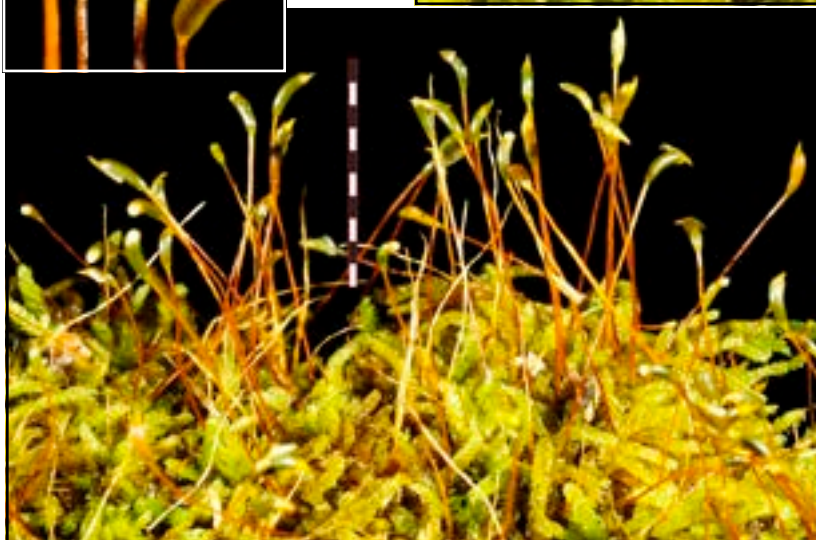


HYPNUM PALLESCENS

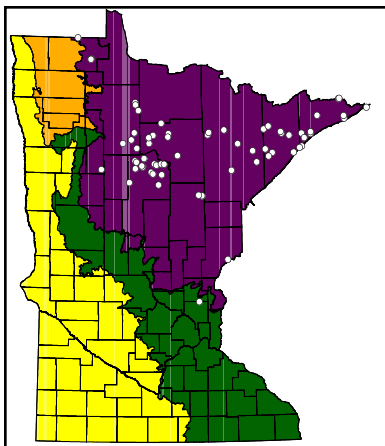
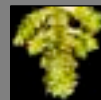


strongly falcate
leaves and curved
capsules (smaller
and shorter than
those of *Callicodium haldanianum*)

right: with the
20x handlens it
might be possible
to see the narrow-
ly recurved leaf
margins



NECKERA PENNATA



Abundance: Frequent (F_{13}).

Habitat and field aspect: Mostly restricted to northern wet conifer forest and wet and very wet ash forest, and to northern cedar/fir swamp. Occasional in northern mesic hardwood forest and fire-dependent mesic mixed forest and woodland. Recorded from northern mesic and wet cliff, and wet meadow/carr. Restricted to growing on bark of tree trunks, usually hardwood, rarely on fallen logs. The **fan-shaped** populations grow usually somewhat elevated from the forest or swamp floor, in a xerophytic microhabitat but often very wet mesohabitat, rarely on rock. On somewhat drier sites the species is commonly growing intermixed with the large leafy liverwort *Porella platyphylla* (F_{20}), similar in growth form.

Aid to Identification: The **pinnately branched plants droop down and at the tip curve outward from the bark to which they are firmly attached**. Both dry and wet, the **strongly complanate leaves are glossy, and distinctly undulate**. The **leaf tips are often broadly**

acute or even apiculate. **Sporophytes** are frequent, and **attached on the underside** (or downward side) of the plants, **sessile**, and enclosed by narrowly acuminate perichaetial leaves.



Look-Alike Species: Only the above mentioned *Porella platyphylla* (F_{20}) is similar in aspect in the field, but on closer inspection proves to be a large leafy liverwort, with highly differentiated underleaves. The plants are also matte rather than glossy as in *Neckera pennata*. No other ecostate nor costate corticolous species in Minnesota has the distinct fan-shaped mat growth form and complanate undulate leaves of *Neckera pennata*.

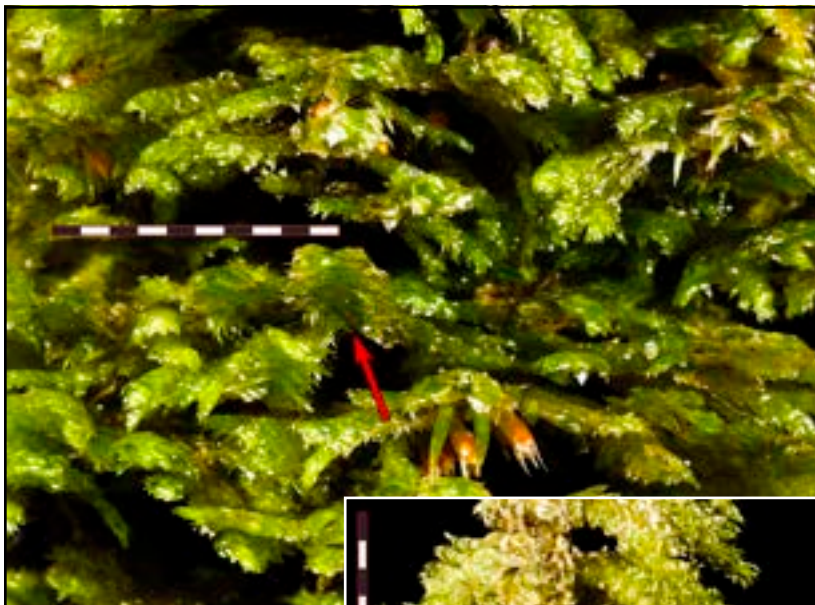
Associated Species: Mesohab: *Callicladium haldanianum*, *Plagiomnium cuspidatum*, *Platygyrium repens*; Microhab: *Callicladium haldanianum*, *Platygyrium repens*, *Hypnum pallescens*; Pop: *Radula complanata*, *Porella platyphylla*, *Platygyrium repens*, *Frullania eboraensis*.

typical population of *Neckera pennata* at breast height on a large hardwood tree (arrow)

note the more shriveled and matte look of the large liverwort *Porella platyphylla* in the lower right corner; when wet, both species look even more alike in field aspect

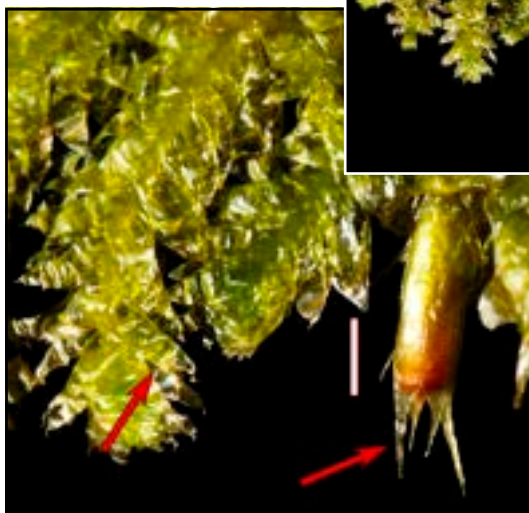


NECKERA PENNATA



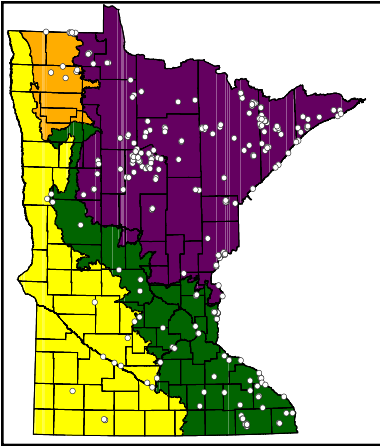
top: the distal part of the plants point horizontally forward, but the main part is attached firmly to the bark, pointing downward (fan growth-form); the sporophytes are sessile (no visible setae) and attached to the underside

middle: the leaves are strongly complanate on the pinnately branched plant, and distinctly undulate (transversely wrinkled); often multiple sporophytes are found



left: leaf tips are acute to apiculate and the sessile capsule is enclosed by narrowly-lanceolate perichaetial leaves extending beyond its operculum

PLATYGYRIUM REPENS



Abundance: Common (C₂₅).

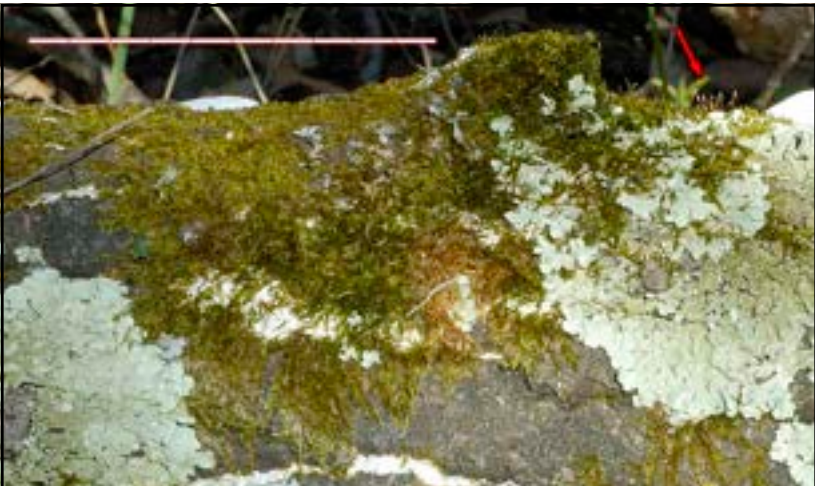
Habitat and field aspect: Common in nearly all northern, central, and southern mesic hardwood classes, and in dry to mesic fire-dependent forest of all regions. Frequent in northern alder, cedar/fir, tamarack, and black spruce swamp. Occasional in northern and southern terrace floodplain forest and wet and very wet ash swamp, and in northern wet conifer forest. Recorded from northern spruce bog, poor conifer swamp, and transitional fen; from northwestern and southern rich conifer swamp and northern open rich fen; from southern open talus; and from northern and southern wet meadow/carr, and even southern dry savanna. Found on nearly all tree trunks with a stable enough bark, and on both corticolous and lignicolous coarse woody debris on the forest and swamp floor. Far more rarely found on terrestrial substrates such as rocks, but sometimes remaining viable for a long time on litter and humus. Most characteristically is the **variegated dull brown-glossy**

green of the larger patches on bark. The mats and most individual **plants adhere strongly to the substrate**. In profile it is usually seen to have sporophytes somewhere on the patch, diagnostically with **straight or only very slightly curved capsules**.

Aid to Identification: On closer inspection it is possible to see the even more diagnostically and often abundantly produced brood bodies or **propagula at the branch tips**. The **ecostate leaves are glossy when dry, slightly curved** but not obviously falcate-secund, and proximally have a **narrowly recurved margin** (20x hand-lens).

Look-Alike Species: Most similar in aspect to *Hypnum pallescens* (C₁₈) and the *Pylaisia* species (C-F), which also occur frequently, often intermixed, on the same tree or log. When no sporophytes with the straight capsules or branches with the characteristic propagula are present, some small patches of *Platygryium repens* might be hard to differentiate from these species. *Hypnum pallescens* has more falcate leaves, and the branches of the *Pylaisia* species grow upright, away from the substrate, often strongly curved.

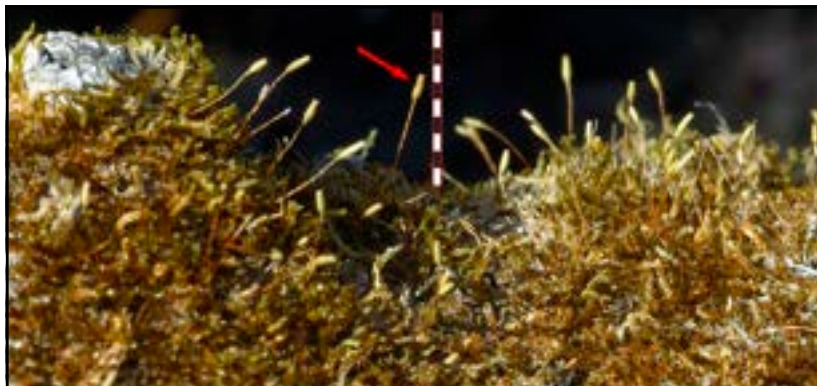
Associated Species: Mesohab: *Plagiomnium cuspidatum*, *Callicladium haldanianum*, *Pleurozium schreberi*, *Dicranum flagellare*, *Lophocolea heterophylla*; Microhab: *Callicladium haldanianum*, *Plagiomnium cuspidatum*, *Hypnum pallescens*; Pop: *Ptilidium pulcherrimum*.



variegated-color aspect of a large patch of *Platygryium repens* on a recently fallen tree trunk in a mesic hardwood forest
note a number of sporophytes, in profile, on the crest of the trunk (arrow)



PLATYGYRIUM REPENS



top and bottom left : the sporophytes have straight to only very slightly curved capsules

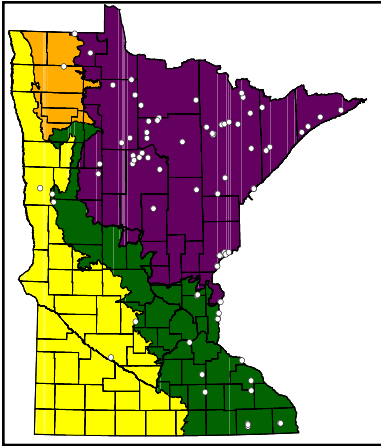
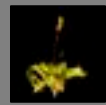
left and below right: many branches are tipped with clusters of small propagula; the regular leaves are only very slightly curved and/or secund



Ecostate Pleurocarps on Bark, Wood, Rock

February 2014

PYLAISIA SELWYNII



Synonym: *Pylaisiella selwynii*.

Abundance: Frequent (F₂₁).

Habitat and field aspect: Frequent in northern wet forest and in mesic hardwood forest throughout the state. Occasional in northern and southern fire-dependent forest / woodland, forested rich peatland, and floodplain forest. Recorded from northern wet meadow/carr and poor conifer swamp. Nearly always found higher up on the bark of tree trunks, rarely on coarse woody debris or rotten wood and rocks. Small patches of **highly glossy plants forming a dense mat of short, upright and curly branches**.

Aid to Identification: The **leaves are slightly curved-secund**, but the **branches**, certainly when the plants are dry, are very **distinctly curved** throughout the patch in one direction. Sporophytes are commonly present and have **erect capsules**.

Look-Alike Species: *Pylaisia polyantha* (C/F₂₀) branches are somewhat less curved, but for critical identification microscopic characters of leaf-cell areolation and peristome structure need to be observed. It is found in even more xerophytic microhabitat than *P. selwynii*, more

common in fire-dependent forest, but also co-occurring with *P. selwynii* in 11% of comprehensive ecotopes. *Platygyrium repens* (C₂₅) and *Hypnum pallescens* (C₁₈) often grow intermixed with the *Pylaisia* species. Both

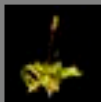
these species have leaves that are narrowly recurved in the lower half, just visible with the 20x handlens, while those of the *Pylaisia* species are plane. *Platygyrium repens* is less glossy and has clusters of brood branches or propagula at the tip of the branches, while *Hypnum pallescens* has much more strongly falcate-secund leaves, and its capsules are curved. Most of the small costate pleurocarps growing on bark of upright tree boles are matte rather than glossy.



top: often with prolific sporophyte production

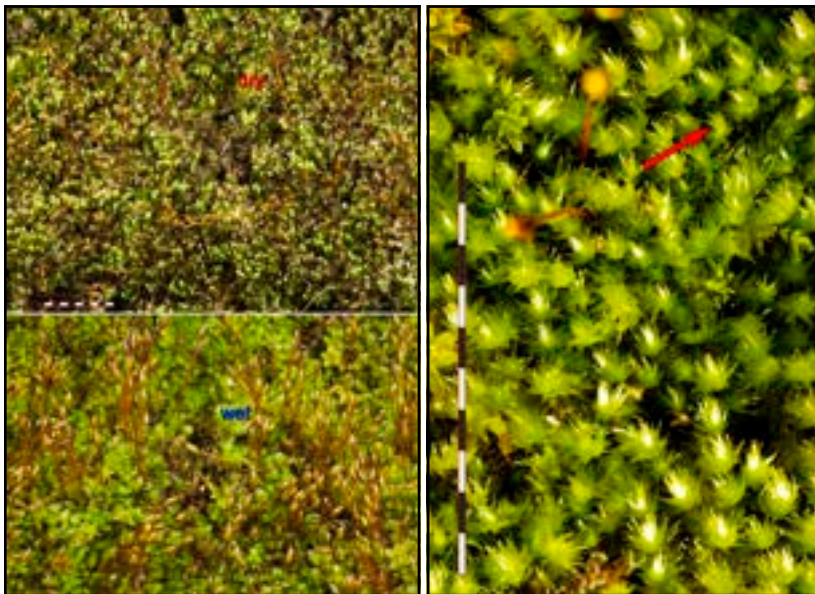
right: when dry the secondary branches are strongly upcurved



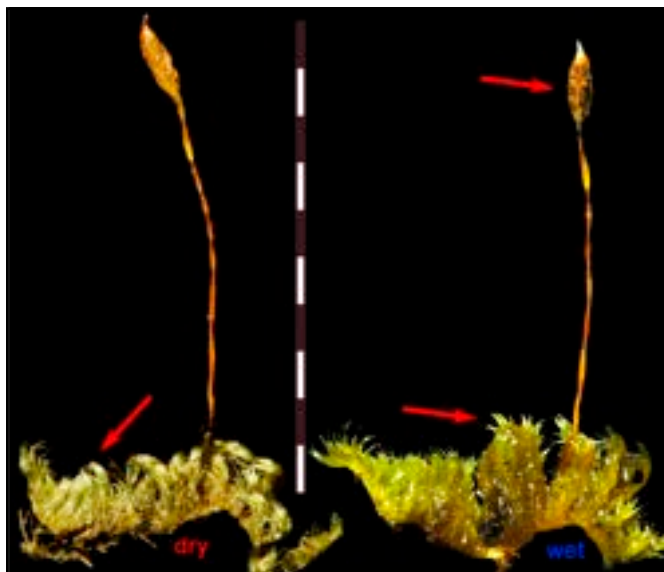


PYLAISIA SELWYNII

Associated Species: Mesohab: *Plagiomnium cuspidatum*, *Platygyrium repens*, *Anomodon minor*, *Callicladium haldanianum*, *Brachythecium salebrosum*, *Haplcladium microphyllum*; Microhab: *Callicladium haldanianum*, *Platygyrium repens*, *Hypnum pallescens*, *Plagiomnium cuspidatum*, *Ptilidium pulcherrimum*, *Brachythecium acuminatum*, *Dicranum flagellare*, *Sanionia uncinata*; Pop: *Frullania eboracensis*, *Orthotrichum obtusifolium*, *Anomodon minor*, *Zygodon viridissimus* var. *rupestris*.



left: strongly curved branches when dry, nearly straight when wet (note the presence of abundant sporophytes)
right: when wet the leaves are only slightly curved-secund and the leaf margins are plane, in contrast with those of *Hypnum pallescens*, which are more strongly falcate-secund and narrowly recurved at the base



the capsules are erect, similarly to those of *Platygyrium repens*, but there are never any brood branches or propagula at the tips of some of the upturned branches

